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Environmental Laboratory

US Army Corps of Engineers®
Engineer Research and Development Center

Wetlands Regulatory Assistance Program

Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Alaska Region (Version 2.0)

U.S. Army Corps of Engineers

September 2007

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U.S. Army Corps of Engineers

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Final report

Prepared for U.S. Army Corps of Engineers
Washington, DC 20314-1000

Abstract: This document is one of a series of Regional Supplements to the Corps of Engineers Wetland Delineation Manual, which provides technical guidance and procedures for identifying and delineating wetlands that may be subject to regulatory jurisdiction under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act. The development of Regional Supplements is part of a nationwide effort to address regional wetland characteristics and improve the accuracy and efficiency of wetland-delineation procedures. This supplement is applicable to the Alaska Region, which is defined as the entire State of Alaska.

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Preface

This document is one of a series of Regional Supplements to the Corps of Engineers Wetland Delineation Manual. It was developed by the U.S. Army Engineer Research and Development Center (ERDC) at the request of Headquarters, U.S. Army Corps of Engineers (USACE), with funding provided through the Wetlands Regulatory Assistance Program (WRAP).

This document was developed in cooperation with the Alaska Regional Working Group, whose members contributed their time and expertise to the project over a period of many months. Working Group meetings were held in Anchorage, AK, on 3–5 February 2004, 16–17 November 2004, and 30 November–1 December 2005. Members of the Regional Working Group and contributors to this document were:

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Technical reviews were provided by the following members of the National Advisory Team for Wetland Delineation: Steve Eggers, U.S. Army Engineer (USAE) District, St. Paul, MN; David Howard, NRCS, Washington, DC; Karl Hipple, NRCS National Soil Survey Center, Lincoln, NE; Dan Martel, USAE District, San Francisco, CA; Jennifer McCarthy, U.S. Army Corps of Engineers, Washington, DC; Norman Melvin, NRCS Central National Technology Support Center, Fort Worth, TX; Paul Minkin, USAE District, New England, Concord, MA; Ralph Thomas Rogers, EPA, Seattle, WA; Stuart Santos, USAE District, Jacksonville, FL; Ralph Spagnolo, EPA, Philadelphia, PA; Ralph Tiner, U.S. Fish and Wildlife Service, Hadley, MA; P. Michael Whited, NRCS, Holden, MA; and James Wood, USAE District, Albuquerque, NM. In addition, portions of this Regional Supplement addressing soils issues were reviewed and endorsed by the National Technical Committee for Hydric Soils (Karl Hipple, chair).

Independent peer reviews were performed in accordance with Office of Management and Budget guidelines. The peer review team consisted of William W. Wood III, chair, NRCS, Palmer, AK; Steve Becker, ASCG Inc., Fairbanks, AK; Janet Kidd, ABR Inc., Fairbanks, AK; Anne Leggett, HDR Alaska, Anchorage, AK; Cheryl Moody, Three Parameters Plus, Palmer, AK; Edmond C. Packee, Jr., Travis-Peterson Environmental Consulting

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Technical editors for this Regional Supplement were Dr. James S. Wakeley, Robert W. Lichvar, and Chris V. Noble, ERDC. Katherine Trott was the project proponent and coordinator at Headquarters, USACE. During the conduct of this work, Dr. Morris Mauney was Chief of the Wetlands and Coastal Ecology Branch; Dr. David Tazik was Chief, Ecosystem Evaluation and Engineering Division; and Dr. Elizabeth Fleming was Director, EL.

COL Richard B. Jenkins was Commander and Executive Director of ERDC. Dr. James R. Houston was Director.

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1 Introduction

Purpose and use of this regional supplement

This document is one of a series of Regional Supplements to the Corps of Engineers Wetland Delineation Manual (hereafter called the Corps Manual). The Corps Manual provides technical guidance and procedures, from a national perspective, for identifying and delineating wetlands that may be subject to regulatory jurisdiction under Section 404 of the Clean Water Act (33 U.S.C. 1344) or Section 10 of the Rivers and Harbors Act (33 U.S.C. 403). According to the Corps Manual, identification of wetlands is based on a three-factor approach involving indicators of hydrophytic vegetation, hydric soil, and wetland hydrology. Indicators are generally site-specific but should be evaluated in a broader context including landscape position, human influences, and other factors. This Regional Supplement presents wetland indicators, delineation guidance, and other information specific to the Alaska Region.

This Regional Supplement is part of a nationwide effort to address regional wetland characteristics and improve the accuracy and efficiency of wetland-delineation procedures. Regional differences in climate, geology, soils, hydrology, plant and animal communities, and other factors are important to the identification and functioning of wetlands. These differences cannot be considered adequately in a single national manual. The development of this supplement follows National Academy of Sciences recommendations to increase the regional sensitivity of wetland-delineation methods (National Research Council 1995). The intent of this supplement is to bring the Corps Manual up to date with current knowledge and practice in the region and not to change the way wetlands are defined or identified. The procedures given in the Corps Manual, in combination with wetland indicators and guidance provided in this supplement, can be used to identify wetlands for a number of purposes, including resource inventories, management plans, and regulatory programs. The determination that a wetland is subject to regulatory jurisdiction under Section 404 or Section 10 must be made independently of procedures described in this supplement.

This Regional Supplement is designed for use with the current version of the Corps Manual (Environmental Laboratory 1987) and all subsequent versions. Where differences in the two documents occur, this Regional Supplement takes precedence over the Corps Manual for applications in the Alaska Region. Table 1 identifies specific sections of the Corps Manual that are replaced by this supplement. Other guidance and procedures given in this supplement and not listed in Table 1 are intended to augment the Corps Manual but not necessarily to replace it. The Corps of Engineers has final authority over the use and interpretation of the Corps Manual and this supplement in Alaska.

Table 1. Sections of the Corps Manual replaced by this Regional Supplement for applications in Alaska.

Item	Replaced Portions of the Corps Manual (Environmental Laboratory 1987)	Replacement Guidance (this Supplement)
Hydrophytic Vegetation Indicators	Paragraph 35, all subparts, and all references to specific indicators in Part IV.	Chapter 2
Hydric Soil Indicators	Paragraphs 44 and 45, all subparts, and all references to specific indicators in Part IV.	Chapter 3
Wetland Hydrology Indicators	Paragraph 49(b), all subparts, and all references to specific indicators in Part IV.	Chapter 4
Growing Season Definition	Glossary	Chapter 4, Growing Season; Glossary
Hydrology Standard for Highly Disturbed or Problematic Wetland Situations	Paragraph 48, including Table 5 and the accompanying User Note in the online version of the Manual	Chapter 5, Wetlands that Periodically Lack Indicators of Wetland Hydrology, Procedure item 3(e)

Indicators and procedures given in this Supplement are designed to identify wetlands as defined jointly by the Corps of Engineers (33 CFR 328.3) and Environmental Protection Agency (40 CFR 230.3). Wetlands are a subset of the “waters of the United States” that may be subject to regulation under Section 404. One key feature of the definition of wetlands is that, under normal circumstances, they support “a prevalence of vegetation typically adapted for life in saturated soil conditions.” Many waters of the United States are unvegetated and thus are excluded from the Corps/EPA definition of wetlands, although they may still be subject to Clean Water Act regulatory jurisdiction (33 CFR 328.3a). Other potential waters of the United States in Alaska include, but are not limited to, tidal waters, lakes, rivers, streams, mud flats, and similar areas. Delineation of these waters is based on the high tide line, the "ordinary high water mark" (33 CFR 328.3e), or other criteria and is beyond the scope of this Regional Supplement.

Amendments to this document will be issued periodically in response to new scientific information and user comments. Between published versions, Headquarters, U.S. Army Corps of Engineers, may provide updates to this document and any other supplemental information used to make wetland determinations under Section 404. Wetland delineators should use the most recent approved versions of this document and supplemental information. See the Corps of Engineers Headquarters regulatory web site for information and updates (http://www.usace.army.mil/inet/functions/cw/cecwo/reg/). The Corps of Engineers has established an interagency National Advisory Team for Wetland Delineation whose role is to review new data and make recommendations for needed changes in wetland-delineation procedures to Headquarters, U.S. Army Corps of Engineers. Items for consideration by the Team, including full documentation and supporting data, should be submitted to:

National Advisory Team for Wetland Delineation
Regulatory Branch (Attn: CECW-CO)
U.S. Army Corps of Engineers
441 G Street, N.W.
Washington, DC 20314-1000

Applicable region

This supplement is applicable to the Alaska Region, which is defined herein as the entire State of Alaska. The whole State was identified for development of this supplement in part because of its geographic isolation from the rest of the United States and in part by its climate, which is typical of high latitudes. Alaska is characterized by a humid temperate climate along the southeastern coast and a polar climate across the rest of the State (Bailey 1998). The polar climate is controlled mainly by polar and arctic air masses. In general, temperatures are low, winters are severe, and annual precipitation is low, much of it occurring during summer. Although day length during summer can be long, the intensity of solar radiation and potential for evapotranspiration are relatively low. Soils are usually frozen during the winter and the growing season is short.

The humid temperate climate of southeastern Alaska is influenced by both polar and tropical air masses and is characterized by warmer temperatures and abundant precipitation. Summers tend to be cool and moist, and the annual temperature range is relatively narrow due to the proximity of the ocean (Bailey 1995, 1998). Wetland indicators presented in this supplement are applicable across the entire State.

Physical and biological characteristics of the region

The Alaska Region encompasses a vast area that extends over 2,400 miles (3,860 km) east to west and over 1,400 miles (2,250 km) north to south. Alaska's land surface covers more than 586,000 square miles (1,517,700 km^2), most of which is located north of 60° N latitude and extends well above the Arctic Circle. Climate, geology, and landforms are highly variable across the region. Northern portions of Alaska are underlain by continuous permafrost, which becomes discontinuous, isolated, and fades away toward the south. Plant communities are also spatially variable, ranging from the grass, sedge, lichen, and dwarf-shrub communities of the arctic tundra to the coniferous rainforests of southeastern Alaska.

Figure 1 provides a generalized map of the subregions of Alaska. Subregions are used in this Regional Supplement to provide additional information that may be helpful in applying wetland indicators in particular areas. Four of these subregions correspond to the following Land Resource Regions (LRR) in Alaska recognized by the USDA Natural Resources Conservation Service (2004): Aleutian Alaska, Interior Alaska, Northern Alaska, and Western Alaska. The fifth LRR (Southern Alaska) has been split into two subregions – Southcentral Alaska and Southeast Alaska – based on differences in vegetation and climate. Detailed descriptions of the subregions of Alaska can be found in U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (2004).

Types and distribution of wetlands

Wetlands are more abundant in Alaska than in any other region of the United States. According to the National Wetlands Inventory, wetlands (including shallow subtidal habitats in coastal areas) occupy more than 174 million acres (70 million ha) and comprise more than 43 percent of the State's surface area (Hall et al. 1994). Nearly 99 percent of Alaska's wetlands are classified as palustrine, of which approximately 67 percent are scrub/shrub, 25 percent are emergent, and 8 percent are forested.

Figure 1. Subregions of Alaska. The entire Aleutian Island chain (not shown) is included in the Aleutian Alaska subregion.

Alaska's wetlands are as varied as its landscapes. They include salt marshes, bogs, muskegs, fresh marshes, swamps, and wet and moist tundra. Wetland abundance varies considerably by subregion and locale. Wetlands occupy an average of 61 percent of Northern and Western Alaska (approximately 93 million acres or 38 million ha of wetlands). They are least abundant in the Brooks Range (approximately 22 percent wetlands) and most abundant (up to 83 percent of the land area) in the arctic foot-hills and coastal plain, and in the Yukon-Kuskokwim and Selawik-Kobuk deltas. Vast expanses of treeless tundra underlain by permafrost dominate the area. More than half of all of Alaska's wetlands are located in the Northern and Western subregions.

In contrast, only about 13 percent of the land area in Southcentral, Southeast, and Aleutian Alaska consists of wetlands (9 million acres or 3.7 million ha). These subregions contain about 5 percent of Alaska's total wetland resource. Wetlands are less abundant in the mountains (less than 3 percent wetlands) and more abundant in the southeastern lowlands (34.5 percent wetlands) and in the Cook Inlet-Susitna lowlands (28 percent wetlands). Slope wetlands are common in the Southeast due to abundant precipitation and shallow bedrock. More than one-third of the wetlands in these subregions are forested.

Approximately 44 percent of Interior Alaska is wetlands (total of 71 million acres or 29 million ha), with the greatest wetland abundances in the Kanuti flats (76.5 percent wetlands), the Koyukuk-Innoko lowlands (71.1 percent), and the Tanana-Kuskokwim lowlands (60.9 percent). Interior Alaska contains approximately 40 percent of the State's total wetland acreage, including millions of acres of black spruce (*Picea mariana*) muskeg and floodplain wetlands dominated by deciduous shrubs and emergent plants. Wetlands are common on north-facing slopes where shallow permafrost traps water near the surface. Seventy-four percent of the wetland area in the subregion is classified as scrub/shrub, 13 percent is forested, and 13 percent is emergent (Hall et al. 1994).

2 Hydrophytic Vegetation Indicators

Introduction

In wetlands, the presence of water for long periods during the growing season exerts a controlling influence on the vegetation and dictates the kinds of plants that can establish and maintain themselves. Therefore, certain characteristics of the vegetation are strong evidence for the presence of wetlands on a site. The Corps Manual uses a plant-community approach to evaluate vegetation. Hydrophytic vegetation decisions are based on the assemblage of plant species growing on a site, rather than the presence or absence of particular indicator species. In general, hydrophytic vegetation is present when the plant community is dominated by species that can tolerate prolonged inundation or soil saturation during the growing season.

Many factors besides site wetness affect the composition of the plant community in an area, including regional climate, local weather patterns, topography, soils, past and present land use, and plant distributional patterns at various spatial scales. Community composition reflects the adaptive capabilities of the plant species and individuals present, superimposed on a complex spatial pattern of hydrologic, edaphic, and other environmental conditions. Disturbance factors, such as floods, fires, drought, or recent site modifications, are also important. They can set back or alter the course of plant succession, and may even change the hydrophytic status of the community. For example, intense fires in wetlands underlain by shallow permafrost and dominated by species such as black spruce can burn both the standing vegetation and the peat layer that insulates and helps maintain the permafrost layer. Thawing of the permafrost, as a result of intense burns, can result in improved soil drainage in some settings and can shift vegetation composition from hydrophytic to non-hydrophytic in one or more growing seasons. This shift in vegetation can last 50 to 70 years in Interior Alaska's black spruce communities before the insulating moss layer develops sufficiently to re-establish both the permafrost layer and original plant community (Viereck et al. 1986). Wetland determinations in such areas depend, in part, on the investigator's assessment of the permanence of the changes in site conditions using all available information and best professional judgment.

In most cases, hydrophytic vegetation decisions are based on the wetland indicator status (Reed 1988 or current approved list) of plant species in the community. Species in the facultative categories (FACW, FAC, and FACU) are recognized as occurring in both wetlands and uplands to varying degrees. Many facultative species have adaptive strategies allowing them to inhabit various landscape positions across the moisture gradient. Most wetlands are dominated by species rated OBL, FACW, and FAC. However, certain uncommon wetland types in Alaska may support primarily FACU species, such as paper birch (*Betula papyrifera*) or field horsetail (*Equisetum arvense*). These situations arise in part due to the broad tolerances of certain plant species that allow them to be widely distributed across the moisture gradient (i.e., ecological plasticity) or to the existence of ecotypes (i.e., populations of a species that are better adapted for life in wetlands than most members of the species). Hydrophytic vegetation indicators and procedures presented in this chapter are designed to identify the majority of wetland plant communities in Alaska. However, some wetland communities may lack any of these indicators. These situations are considered in Chapter 5 (Difficult Wetland Situations in Alaska).

Guidance on vegetation sampling

General guidance

Guidance on sampling of vegetation for wetland-delineation purposes is given in the Corps Manual for both the Routine and Comprehensive methods. Those procedures are intended to be flexible and often need to be modified for application in a given region or on a particular site. The following guidance on vegetation sampling is intended to supplement the Corps Manual for applications in Alaska.

Vegetation sampling done as part of a wetland delineation is designed to characterize the site in question rapidly without the need for detailed scientific study or statistical methods. A balance must be struck between the need to accomplish the work quickly and the need to characterize the site's heterogeneity accurately and at an appropriate scale.

The first step is to stratify the site so that the major landscape forms can be evaluated separately. This may be done using an aerial photograph or topographic map ahead of time or by walking over the site sufficiently to identify vegetation units associated with key landscape forms. In general, routine wetland determinations are based on visual estimates of percent cover of plant species that can be made either (1) within the vegetation unit as a whole or (2) within one or more sampling plots established in representative locations within each unit. Percent cover estimates are more accurate and repeatable if taken within a defined plot. This also facilitates field verification of another delineator's work. The sizes and shapes of plots, if used, may be modified as appropriate to adapt to site conditions and should be recorded on the field data form. Near the wetland boundary, it may be necessary to adjust plot size or shape to avoid overlapping the boundary and extending into an adjacent community having different vegetation, soils, or hydrologic conditions. If the site is topographically diverse, procedures for wetland/non-wetland mosaics may be needed (see Chapter 5).

If it is not possible to locate one or a few plots in a way that adequately represents the landscape unit being sampled, then percent cover can be estimated by walking the unit and visually estimating the coverage of each species over a broader area. If additional quantification of cover estimates is needed, point-intercept sampling along transects (see Appendix B) may be used to characterize the vegetation within a landscape unit, as long as soil and hydrologic conditions are uniform across the area.

Definitions of strata

Vegetation strata help facilitate plant sampling and ensure that plants of all sizes are considered in the hydrophytic vegetation determination. The structure of vegetation varies greatly in wetland communities across the state. Throughout much of Alaska, short-statured woody plants are an important part of many communities, such as muskegs, bogs, and tundra wetlands. Important information about the wetland status of the community can be lost when short woody plants are combined into the herb stratum for sampling, as suggested in the Corps Manual. Therefore, the following strata are suggested for use in Alaska. This system places short woody shrubs in the sapling/shrub stratum and limits the herb stratum to only herbaceous vascular plant species. Unless otherwise noted, any stratum with less than 5 percent total plant cover during the peak of the growing season may be combined with another stratum for sampling purposes. Generally, a sparse tree stratum would be combined with the sapling/shrub stratum, and vice versa. A sparse herb stratum may be combined with the sapling/shrub stratum. Non-vascular plant species (e.g., mosses, liverworts) are not used in hydrophytic vegetation decisions except in certain disturbed or problematic situations (see Chapter 5).

1. *Tree stratum* – Consists of woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.
2. *Sapling/shrub stratum* – Consists of woody plants less than 3 in. DBH, regardless of height.
3. *Herb stratum* – Consists of all herbaceous (non-woody) plants, regardless of size.

Hydrophytic vegetation indicators

The Corps Manual defines hydrophytic vegetation as the community of macrophytes that occurs in areas where inundation or soil saturation is either permanent or of sufficient frequency and duration to exert a controlling influence on the plant species present. Hydrophytic vegetation in Alaska is identified by using the indicators described in this section.

Indicators of hydrophytic vegetation involve looking up the wetland indicator status of plant species on the wetland plant list (Reed 1988 or current list). To use the indicators, at least 80 percent of the total vegetation cover on the plot must be of species that have been correctly identified and have an assigned wetland indicator status. For species with no regional indicator (designated NI) or those species whose occurrence in Alaska was not known at the time the plant list was developed (designated NO), do not use the species to calculate hydrophytic vegetation indicators. In general, species that are not listed on the wetland plant list are assumed to be upland (UPL) species. However, recent changes in plant nomenclature and distributions have resulted in a number of species that are not listed by Reed (1988) but are not necessarily UPL plants. Examples include *Gaultheria shallon*, *Menziesia ferruginea*, *Prunus padus*, *Vaccinium parvifolium*, and *Viola epipsila* ssp. *repens*. Procedures described in Chapter 5, Wetlands that Lack Indicators of Hydrophytic Vegetation, can be used if it is believed that individual FACU, NI, NO, or unlisted plant species are functioning as hydrophytes on a particular site.

The following indicators should be applied in the sequence presented. Hydrophytic vegetation is present if any of the indicators is satisfied. One of the indicators has the additional requirement that indicators of hydric soil and wetland hydrology must also be present. All of the indicators are applicable throughout Alaska.

The Dominance Test (Indicator 1) and Prevalence Index (Indicator 2) are the basic hydrophytic vegetation indicators in Alaska. The vegetation is hydrophytic if either test is satisfied. The dominance test is most appropriate when a few plant species are much more abundant than the other species in the community. The dominance test can be unreliable, however, when only one or two dominants are present or when strata are very different in total plant cover. The prevalence index is a more comprehensive analysis of the plant community because it accounts for all species present, not just a few dominants. It is particularly suited to communities with moderate cover values for several species, or where one stratum contains much less plant cover than another stratum (e.g., in bogs containing scattered trees). When determining dominance, consideration should be given to the maturity of herbaceous species. Cover values may be biased toward woody species in early and late-season determinations. Most wetlands in Alaska have plant communities that will meet one or both of these indicators and they are the only indicators that need to be used in most situations. However, some unusual wetland communities may fail both indicators due to the prevalence of FACU species even on clearly wet sites. In those cases, if indicators of hydric soil and wetland hydrology are both present, then the vegetation should be reevaluated using Indicator 3 (Morphological Adaptations). Finally, certain disturbed or problematic wetland situations may lack any of these indicators and are described in Chapter 5. The procedure for using hydrophytic vegetation indicators is as follows:

1. Apply Indicators 1 (Dominance Test) and/or 2 (Prevalence Index).
    a. If either indicator is satisfied, then the vegetation is hydrophytic and no further vegetation analysis is required.
    b. If neither indicator is satisfied and indicators of hydric soil and/or wetland hydrology are absent, then hydrophytic vegetation is absent unless the site meets requirements for a problematic wetland situation (see Chapter 5).
    c. If neither indicator is satisfied but indicators of hydric soil and wetland hydrology are both present, proceed to Step 2.
2. Apply Indicator 3 (Morphological Adaptations). This step assumes that at least one indicator of hydric soil and one primary or two secondary indicators of wetland hydrology are present.
    a. If Indicator 3 is satisfied, then the vegetation is hydrophytic.

b. If Indicator 3 is not satisfied, then hydrophytic vegetation is absent unless the site meets the requirements for a problematic wetland situation (Chapter 5).

Indicator 1: Dominance test

Description: More than 50 percent of the dominant plant species across all strata are rated OBL, FACW, or FAC.

User Notes: Use the 50/20 rule described below to select dominant species from each stratum of the community. Combine dominant species across strata and apply the dominance test to the combined list. Once a species is selected as a dominant, its cover value is not used in the dominance test; each dominant species is treated equally. Thus, a plant community with seven dominant species across all strata would need at least four dominant species that are OBL, FACW, or FAC to be considered hydrophytic by this indicator. Woody species that are dominant in two strata should be counted twice in the dominance test. It is recommended that all plant species making up at least 80 percent of the total vegetation cover on the plot be identified and their absolute cover values listed on the data form.

Procedure for Selecting Dominant Species by the 50/20 Rule: Dominant plant species are the most abundant species in the community; they contribute more to the character of the community than do the other non-dominant species present. The "50/20 rule" is a repeatable and objective procedure for selecting dominant plant species and is recommended when data are available for all species in the community. The rule can also be used to guide visual sampling of plant communities in rapid wetland determinations.

Dominant species are chosen independently from each stratum of the community. In general, dominants are the most abundant species that individually or collectively account for more than 50 percent of the total coverage of vegetation in the stratum, plus any other species that, by itself, accounts for at least 20 percent of the total. For the purposes of this regional supplement, absolute percent cover is the recommended abundance measure for plants in all vegetation strata. See Table 2 for an example application of the 50/20 rule in evaluating a plant community.

Table 2. Example of the selection of dominant species by the 50/20 rule and determination of hydrophytic vegetation by the dominance test.

Stratum	Species Name	Wetland Indicator Status	Absolute Percent Cover	Dominant?
Herb	*Matteuccia struthiopteris*	FACW	40	Yes
	Impatiens noli-tangere	FACW	20	Yes
	Equisetum arvense	FACU	10	No
	Ribes hudsonianum	FAC	10	No
	Thalictrum sparsiflorum	FACU	10	No
	Calamagrostis canadensis	FAC	5	No
	Dryopteris dilatata	FACU	5	No
	Oplopanax horridus	FACU	5	No
	Streptopus amplexifolius	FAC	5	No
		Total cover	110	
		50/20 Thresholds: 50% of total cover = 55% 20% of total cover = 22%		
Sapling/shrub	*Salix alaxensis*	FAC	80	Yes
	Populus balsamifera	FACU	10	No
	Alnus sinuata	FAC	10	No
		Total cover	100	
		50/20 Thresholds: 50% of total cover = 50% 20% of total cover = 20%		
Tree	*Populus balsamifera*	FACU	10	Yes
Hydrophytic Vegetation Determination	Total number of dominant species across all strata = 4. Percent of dominant species that are OBL, FACW, or FAC = 3/4 = 75%. Therefore, this community is hydrophytic by Indicator 1 (Dominance Test).			

Steps in selecting dominant species by the 50/20 rule are as follows:

1. Estimate the absolute percent cover of each species in the first stratum. Since the same data may be used to calculate the prevalence index, the data should be recorded as absolute cover and not converted to relative cover.
2. Rank all species in the stratum from most to least abundant.
3. Calculate the total coverage of all species in the stratum (i.e., sum their individual percent cover values). Absolute cover estimates do not necessarily sum to 100 percent.
4. Select plant species from the ranked list, in decreasing order of coverage, until the cumulative coverage of selected species *exceeds* 50 percent of the total coverage for the stratum. If two or more species are equal in coverage (i.e., they are tied in rank), they should all be selected. The selected plant

species are all considered to be dominants. All dominants must be identified to species.

5. In addition, select any other species that, by itself, is at least 20 percent of the total percent cover in the stratum. Any such species is also considered to be a dominant and must be accurately identified.
6. Repeat steps 1–5 for any other stratum present. Combine the lists of dominant species across all strata. Note that a species may be dominant in more than one stratum (e.g., a woody species may be dominant in both the tree and sapling/shrub strata).

Indicator 2: Prevalence index

Description: The prevalence index is 3.0 or less.

User Notes: If practical, all species in the plot should be identified and recorded on the data form. At a minimum, at least 80 percent of the total vegetation cover on the plot (summed across all strata) must be of species that have been correctly identified and have assigned wetland indicator statuses (Reed (1988) or current list) or are upland (UPL) species.

Procedure for Calculating a Plot-Based Prevalence Index: The prevalence index is a weighted-average wetland indicator status of all plant species in the sampling plot or other sampling unit, where each indicator status category is given a numeric code (OBL = 1, FACW = 2, FAC = 3, FACU = 4, and UPL = 5) and weighting is by abundance (absolute percent cover). It is a more comprehensive analysis of the hydrophytic status of the community than one based on just a few dominant species. The method was described by Wentworth et al. (1988) and modified by Wakeley and Lichvar (1997). It uses percent cover estimates for each plant species in the plot, with the constraint that at least 80 percent of the total vegetation cover on the plot must be of species that have been correctly identified and have an assigned wetland indicator status (including UPL). For any species that occurs in more than one stratum, cover estimates are summed across strata. The following procedure is used to calculate a plot-based prevalence index:

1. Identify and estimate the absolute percent cover of each species in each stratum of the community. Sum the cover estimates for any species that is present in more than one stratum.
2. Organize all species (across all strata) into groups according to their wetland indicator status (i.e., OBL, FACW, FAC, FACU, or UPL) and sum their

cover values within groups. Do not include species that were not identified or have an NI or NO status.

3. Calculate the prevalence index using the following formula:

$$PI = \frac{A_{OBL} + 2A_{FACW} + 3A_{FAC} + 4A_{FACU} + 5A_{UPL}}{A_{OBL} + A_{FACW} + A_{FAC} + A_{FACU} + A_{UPL}}$$

where:

PI = Prevalence index
A_{OBL} = Summed percent cover values of obligate (OBL) plant species
A_{FACW} = Summed percent cover values of facultative wetland (FACW) plant species
A_{FAC} = Summed percent cover values of facultative (FAC) plant species
A_{FACU} = Summed percent cover values of facultative upland (FACU) plant species
A_{UPL} = Summed percent cover values of upland (UPL) plant species.

The prevalence index should range between 1 and 5. See Table 3 for an example calculation of the prevalence index using the same data as in Table 2. The following web link provides free public-domain software for simultaneous calculation of the 50/20 rule, dominance test, and prevalence index: http://www.crrel.usace.army.mil/rsgisc/wetshed/wetdatashed.htm.

Indicator 3: Morphological adaptations

Description: The plant community passes Indicator 1 (Dominance Test) or Indicator 2 (Prevalence Index) after reconsideration of the indicator status of certain plants that exhibit morphological adaptations for life in wetlands.

User Notes: Some hydrophytes in Alaska develop easily recognized physical characteristics, or morphological adaptations, when they occur in wetland areas. These adaptations may help them to survive prolonged inundation or saturation in the root zone, or they may simply be a consequence of living under such wet conditions. The most common morphological responses to wetland conditions in Alaska are changes in growth form of certain plants, such as stunting or reduced vigor due to stress.

Table 3. Example of the prevalence index using the same data as in Table 2.

Indicator Status Group	Species Name	Percent Cover by Species	Total Cover by Group	Multiply by:[1]	Product
OBL species	None	0	0	1	0
FACW species	*Matteuccia struthiopteris* *Impatiens noli-tangere*	40 20	60	2	120
FAC species	*Ribes hudsonianum* *Calamagrostis canadensis* *Streptopus amplexifolius* *Salix alaxensis* *Alnus sinuata*	10 5 5 80 10	110	3	330
FACU species	*Equisetum arvense* *Thalictrum sparsiflorum* *Dryopteris dilatata* *Oplopanax horridus* *Populus balsamifera*[2]	10 10 5 5 20	50	4	200
UPL species	None	0	0	5	0
Sum			220 (A)		650 (B)
Hydrophytic Vegetation Determination		Prevalence Index = B/A = 650/220 = 2.95 Therefore, this community is hydrophytic by Indicator 2 (Prevalence Index).			

[1] Where OBL = 1, FACW = 2, FAC = 3, FACU = 4, and UPL = 5.

[2] This species was recorded in two strata (see Table 2) so the cover estimates were summed across strata.

Morphological adaptations may develop on FACU species when they occur in wetlands, indicating that those individuals are capable of functioning as hydrophytes. Examples of growth form responses for common species encountered during wetland determinations in Alaska are given in Table 4.

Table 4. Stress/vigor examples for four species frequently encountered during wetland determinations in Alaska.

Species	Growth Form Response
Paper birch (*Betula papyrifera*)	Stressed trees growing in wet conditions tend to be stunted, have multiple trunks, have an “apple tree”-like growth form, are reduced in size, and many times have a rotten core in the tree trunk.
White spruce (*Picea glauca*)	Under wet conditions, the needles are farther apart, branching is less bushy, and the growth form more narrow in shape.
Black spruce (*Picea mariana*)	Under wet conditions, trees have a shorter stature, asymmetrical shape, narrower growth form, and reduced volume for their age. On drier sites, the growth form is large and has an appearance similar to white spruce.
Sitka spruce (*Picea sitchensis*)	Under wet conditions, the main growth response is stunting.

To apply this indicator, these morphological features must be observed on more than 50 percent of the individuals of a FACU species living in an area where indicators of hydric soil and wetland hydrology are present. Follow this procedure:

1. Confirm that the morphological feature is present mainly in the potential wetland area and is not also common on the same species in the surrounding non-wetlands. This determination may be accomplished over a broad area and is not limited to the project site.
2. For each FACU species that exhibits morphological adaptations, estimate the percentage of individuals that have the features. Record this percentage on the data form.
3. If more than 50 percent of the individuals of a FACU species have morphological adaptations for life in wetlands, that species is considered to be a hydrophyte and its indicator status on that plot should be re-assigned as FAC. All other species retain their published indicator statuses. Record any supporting information on the data sheet, including a description of the morphological adaptation(s) present and any other observations of the growth habit of the species in adjacent wetland and non-wetland locations (photo documentation is recommended).
4. Reapply the Dominance Test (Indicator 1) and/or Prevalence Index (Indicator 2) using a FAC indicator status for this species. The vegetation is hydrophytic if either indicator is satisfied.

3 Hydric Soil Indicators

Introduction

The National Technical Committee for Hydric Soils (NTCHS) defines a hydric soil as a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (USDA Soil Conservation Service 1994). Nearly all hydric soils exhibit characteristic morphologies that result from repeated periods of saturation or inundation for more than a few days. Saturation or inundation, when combined with microbial activity in the soil, causes the depletion of oxygen. This anaerobiosis promotes certain biogeochemical processes, such as the accumulation of organic matter and the reduction, translocation, or accumulation of iron and other reducible elements. These processes result in distinctive characteristics that persist in the soil during both wet and dry periods, making them particularly useful for identifying hydric soils in the field.

This chapter presents indicators that are designed to help identify and delineate hydric soils in Alaska. Indicators are not intended to replace or relieve the requirements contained in the definition of a hydric soil. Therefore, a soil that meets the definition of a hydric soil is hydric whether or not it exhibits indicators. This list of indicators is dynamic; changes and additions are anticipated with new research and field testing. Indicators presented in this chapter are a subset of the NTCHS *Field Indicators of Hydric Soils in the United States* (USDA Natural Resources Conservation Service 2006 or current version) that are commonly found in Alaska. Any change to the NTCHS *Field Indicators of Hydric Soils in the United States* represents a change to this subset of indicators for Alaska. Wetland delineators should use the most current version of the indicators, which can be found on the NRCS hydric soils web site (http://soils.usda.gov/use/hydric). To use the indicators properly, a basic knowledge of soil/landscape relationships is necessary.

All of the indicators presented in this Supplement are applicable statewide although some are more common in certain subregions. The User Notes for each indicator provide information specific to each subregion. It is important to note that boundaries between subregions are actually broad transition zones and that soil and landscape conditions do not change abruptly at the boundary.

The indicators are used to help identify the hydric soil component of wetlands; however, some hydric soils do not have any of the currently listed indicators. The absence of any listed indicator does not preclude the soil from being hydric. Guidance for identifying hydric soils that lack indicators can be found in this chapter (see the sections on documenting the site and its soils) and in Chapter 5 (Difficult Wetland Situations in Alaska).

Notes on Alaska soils

The following background information on soil development in Alaska and guidance for soil sampling was adapted from USDA Natural Resources Conservation Service (2005a).

Organic matter accumulation

Saturated or inundated soils. Since the efficiency of soil microbes is considerably lower in a saturated and anaerobic environment, less organic matter and organic carbon is consumed by the microbes. Organic matter and carbon begin to accumulate. The result is the development of thick organic surfaces on the soil (Figure 2) or dark organic-rich surface mineral layers.

Figure 2. A saturated organic soil. In this profile, saturated organic material extends from the soil surface to a depth below 24 in. (60 cm). Scale is in centimeters.

Non-saturated or non-inundated soils. Cool temperatures and acid conditions result in the slow decomposition of organic matter. Therefore, many well-drained soils in Alaska, under aerobic conditions, have thick organic surface layers called Folists or folistic epipedons. These layers are not an indication of diminished microbial activity in a saturated anaerobic environment. Folistic layers are organic accumulations that do not saturate for more than 30 days and, in many cases, do not saturate during most years. Most folistic layers are comprised of poorly decomposed organic material and usually are found in forested areas with greater than 10 percent slopes. Folistic surface layers may overlie rock, a mineral layer, or saturated organic layers. Saturated organics, if underlying an unsaturated organic layer, will usually be more decomposed and have a greasy feel when rubbed between the fingers. It may be necessary to involve a soil scientist with local knowledge to distinguish folistic surface layers from saturated organic layers.

Iron reduction, translocation, and accumulation

Saturated or inundated soils. In an anaerobic environment, soil microbes reduce ferric iron (Fe^{+3}) to ferrous iron (Fe^{+2}). Areas in the soil where iron is reduced develop characteristic bluish-gray or greenish-gray colors known as *gley*. Ferric iron is insoluble but ferrous iron easily enters the soil solution and is moved or translocated to other areas of the soil. Areas that have lost iron develop characteristic gray or reddish-gray colors and are known as *redox depletions*. If a soil reverts to an aerobic state, iron that is in solution will oxidize and become concentrated in patches, often along root channels and other soil pores. These areas of oxidized iron are called *redox concentrations*. Since water movement in these saturated or inundated soils can be multi-directional, redox depletions and concentrations can occur anywhere in the soil (Figure 3). Zones that are iron-depleted due to saturation and reduction normally occur as irregularly shaped or discontinuous patches and zones. Redox concentrations occur either as discontinuous patches or are found along root

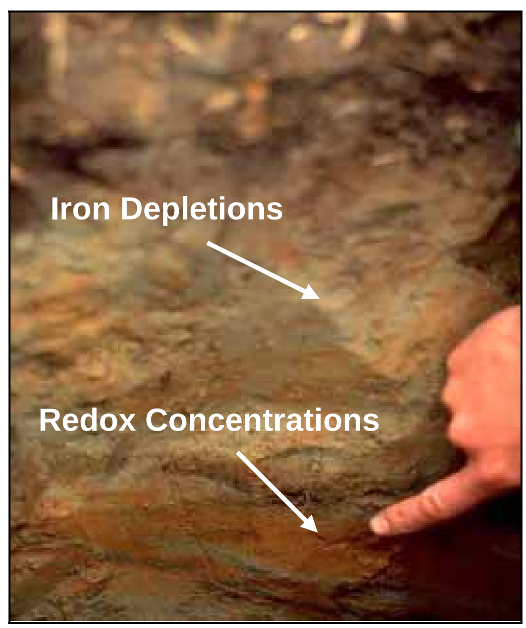

Figure 3. Redox depletions and redox concentrations in a hydric soil.

channels and other pores. Soils that are saturated and contain ferrous iron at the time of sampling may change color upon exposure to the air, as ferrous iron is rapidly converted to ferric iron in the presence of oxygen. Such soils are said to have a *reduced matrix* (Vepraskas 1992).

Non-saturated or non-inundated soils. In well-drained, aerated soils, iron translocation is also a normal process. Infiltrating water moves downward through the soil and, together with the presence of organic acids, leaches or washes iron from mineral layers near the top of the soil. The iron moves in solution downward and accumulates in lower layers. As the near-surface layers are continually leached, their colors become similar to those of iron depletions. The accumulation of iron in the lower horizons may result in colors similar to redox concentrations. This coloration is most pronounced in Spodosols.

Spodosols (Figure 4) form in relatively acidic soil material. Spodosols can be either hydric or non-hydric. They are most common in forested areas or upper mountain slopes in southern Alaska but also occur elsewhere. Organic carbon, iron, and aluminum are leached from a layer near the soil surface. This layer, known as the E horizon, has a bleached light-gray appearance and consists of relatively clean particles of sand and silt. The materials leached from the E horizon are deposited lower in the soil in the spodic horizon (e.g., Bhs or Bs horizon). If sufficient iron has been leached and redeposited, the spodic horizon will have a strong reddish color. In some Spodosols, both E horizon and spodic horizon colors can be confused with the redox depletions and concentrations that result from anaerobic soil conditions.

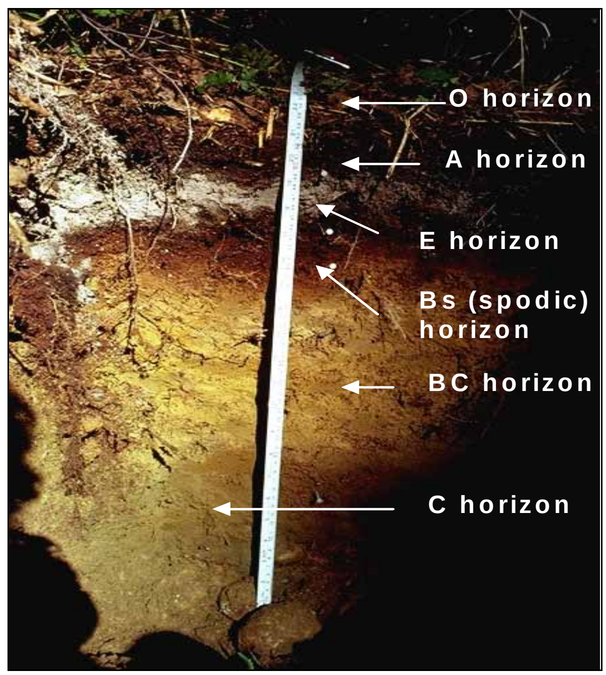

Figure 4. Example of a non-hydric Spodosol.

Normally, E horizon and spodic horizon materials are present in the soil in relatively continuous horizontal bands (Figure 4). Chemical weathering in an aerated soil is accomplished by the downward movement of water;

therefore, the layers or horizons are relatively parallel to the soil surface and consistent across the soil. Transitions are relatively abrupt between the organic surface, the leached E horizon, and the iron-enriched B horizon. Below the B horizon, the transition becomes more gradual with the red hue of the iron-enriched B horizon gradually changing to the yellower hue of the underlying C horizon.

If E horizons are thin or there are extensive plant roots, however, they may be discontinuous. Tree throw and cryoturbation can also mix and break the horizons of aerated upland soils (Figure 5), so care should be taken to examine all site characteristics before concluding that a soil is hydric.

Figure 5. A well-drained Spodosol with strong E and Bh (spodic) horizons. Horizons have been broken and mixed by tree throw. Care is needed not to confuse these with redox depletions and redox concentrations caused by soil saturation and anaerobiosis.

Sulfate reduction

Sulfur is one of the last elements to be reduced by microbes in an anaerobic environment. The microbes convert SO_4^{-2} to H_2S, or hydrogen sulfide. This results in a very pronounced "rotten egg" odor in some soils that are inundated or saturated for very long periods. In non-saturated or non-inundated soils, sulfate is not reduced and there is no rotten egg odor.

Confusing redox concentrations

Some soils have obvious redox concentrations but the site has little or no evidence of wetland hydrology or vegetation. These include the following situations:

Seasonal-frost-affected soils. Seasonal frost is prevalent in areas with little snow cover or where wind commonly removes the snow cover. The seasonal frost forms a nearly impermeable layer similar to permafrost. During break-up, melt water perches on the seasonal frost layer, often resulting in near-surface saturation or ponding. The seasonal frost then degrades within one to two weeks and the soil's normal permeability resumes. The saturated conditions often result in redoximorphic features in the soil (Figure 6). True gley colors rapidly change to non-gley hues once oxidation is present, although redox concentrations remain.

Figure 6. Redox concentrations formed as a result of melt water perching on seasonal frost.

Many of these soils are hydric, although they occur on landscape positions that are normally considered to be well-drained uplands. It is critical to observe carefully and note all other site characteristics, including indicators of hydrophytic vegetation and wetland hydrology, before classifying the area as either wetland or non-wetland.

Thawed permafrost-affected soils. In most soils affected by permafrost, the permafrost forms a restrictive layer that will perch water. In many such soils, the active layer above the permafrost table is saturated long enough during the growing season so that reduced conditions occur. Redoximorphic features and hydric soil indicators are often present (Figure 7).

Figure 7. Thawed permafrost-affected soil. Redox concentrations remain 25 years after drainage improved.

If a natural or cultural activity, such as wildfire or land clearing, disturbs the surface organic layer, the temperature of a permafrost-affected soil may increase. This increase can result in enough thawing that the restrictive permafrost layer is either lowered in the soil profile or completely removed. If the soil occurs in an upland position and has no other restrictive layers, drainage can improve significantly. Similar to soils affected by seasonal frost, gley colors will alter to non-gley hues, but redox concentrations will persist. Therefore, hydric soil indicators may be present even though wetland hydrology has been lost. It is critical to observe carefully and note all other site characteristics, including vegetation and hydrology, before making the wetland determination.

Cautions

A soil that is artificially drained or protected (for instance, by dikes or levees) is still hydric if the soil in its undisturbed state would meet the definition of a hydric soil. To be determined hydric, these soils should generally have one or more of the indicators.

Morphological features of hydric soils indicate that saturation and anaerobic conditions have existed under either contemporary or recent hydrologic conditions. Features that do not reflect contemporary or recent hydrologic conditions of saturation and anaerobiosis are relict features. Typically, contemporary and recent hydric soil features have diffuse boundaries; relict hydric soil features have abrupt boundaries (Vepraskas 1992). When soil morphology seems inconsistent with the landscape, vegetation, or observable hydrology, it may be necessary to obtain the assistance of an experienced soil or wetland scientist to determine whether soil features are relict.

Procedures for sampling soils

Observe and document the site

The common temptation is to excavate a small hole in the soil, note the presence of any indicators, make a decision, and leave. Before any decision is made, however, the overall site and how it interacts with the soil should be considered.

The questions below, while not required to identify a hydric soil, should be considered at any site. Always look at the landscape features of the immediate site and compare them to the surrounding areas. Try to contrast the features of wet and dry sites that are in close proximity. When observing slope features, look first at the area immediately around the sampling point. For example, a nearly level bench or depression at the sampling point may be more important to site wetness than the overall landform on which it occurs. By understanding how water moves across the site, the reasons for the presence or absence of hydric soil indicators should be clear.

If one or more of the hydric soil indicators given later in this chapter is present, then the soil is hydric. If no hydric soil indicators are present, the additional site information below may be useful in documenting whether the soil is indeed non-hydric or if it might represent a “problem” hydric soil.

- *Hydrology*–Is standing water observed on the site or is water observed in the soil pit? What is the water-table depth in the area?
- *Slope*–Is the site level or nearly level so that surface water does not run off readily, or is it steeper where surface water would run off from the soil?
- *Slope shape*–Is the surface concave, where water would tend to collect and possibly pond on the soil surface? On hillsides, are there convergent slopes, where surface or groundwater may be directed toward a central stream or swale, or is the surface or slope shape convex, causing water to run off or disperse?
- *Landform*–Is the soil on a low terrace or floodplain that is subject to seasonal high water tables or flooding? Is it at the toe of a slope where runoff may tend to collect or groundwater may discharge at or near the surface?
- *Soil materials*–Is there a restrictive layer in the soil that would slow or prevent the infiltration of water? This could include permafrost, consolidated bedrock, a layer of silt, substantial clay content, or dense glacial till. Alternatively, is there relatively loose soil material (sand, gravel, or rocks) or fractured bedrock that would allow the soil to drain readily?
- *Vegetation*–Does the vegetation at the site indicate wetter conditions than at other nearby sites, or is it similar to that found on nearby non-wetland sites?

Observe and document the soil

To document a hydric soil, first remove all loose leaves, needles, or bark from the soil surface. Do not remove the organic surface layers of the soil, which usually consist of dead moss and other plant remains in varying stages of decomposition. Dig a hole and describe the soil profile to a depth of at least 20 in. (50 cm) from the soil surface, unless bedrock is found at a shallower depth. Use the completed soil profile description to determine which indicators have been matched.

In general, the hole should be dug to the depth needed to document an indicator or to confirm the absence of indicators. Deeper examination of the soil may be required when field indicators are not easily seen within 20 in. (50 cm) of the surface. It is always recommended that soils be excavated and described as deep as necessary to make reliable interpretations. For example, examination to less than 20 in. (50 cm) may suffice in soils with surface horizons of saturated organic material. Conversely, the excavation depth will often need to be greater than 20 in. (50 cm) in soils with thick dark surface horizons because the upper horizons of these soils, due to the masking effect of organic material, often contain no easily visible redoximorphic features. At many sites, it is necessary to make exploratory observations to 40 in. (1 m) or more. These observations should be made with the intent of documenting and understanding the variability in soil properties and hydrologic relationships on the site.

Whenever possible, excavate the soil deep enough to determine if there are layers or materials present that might restrict soil drainage. This will help to understand why the soil may or may not be hydric.

To determine if a hydric soil indicator is present, it is critical to know exactly where to begin looking. All of the indicators require the presence of certain soil colors or features within specified depths from the soil surface. For the purpose of identifying hydric soils in Alaska, the soil surface begins at the top of the first mineral layer (underneath any and all organic material) except for the application of Indicators A1 (Histosol or Histel) and A2 (Histic Epipedon). For A1 and A2, the soil surface starts just below the living, green moss layer. The majority of Alaska soils have an organic surface layer.

All colors noted in this supplement refer to moist Munsell colors. Soil colors specified in the indicators do not have decimal points; however, intermediate colors do occur between Munsell chips. Soil chroma should not be rounded to qualify as meeting an indicator. For example, a soil matrix with a chroma between 2 and 3 should be listed as having a chroma of 2+. This soil material does not have a chroma of 2 and would not meet any indicator that requires a chroma of 2 or less.

Particular attention should be paid to changes in microtopography over short distances. Small changes in slope configuration may result in repetitive sequences of hydric/non-hydric soils, and the delineation of individual areas of hydric and non-hydric soils may be difficult. Often the dominant condition, either hydric or non-hydric, is the only reliable interpretation. The shape of the local landform can greatly affect the movement of water through the landscape. Significant changes in parent material or lithologic discontinuities in the soil can also affect the hydrologic properties of the soil. After a sufficient number of exploratory excavations have been made to understand the soil/hydrology relationships at the site, subsequent excavations can be limited to the depth needed to identify hydric soil indicators.

Take photos of both the soil and the overall site. There may be no opportunity to return for more data.

Use of existing soil data

Soil surveys

Soil surveys are available for many areas of Alaska and can provide useful information regarding soil properties and soil moisture conditions for an area. Soil surveys in Alaska, however, vary considerably in the mapping scale and the amount of ground-truthing used to document the survey. A list of available soil surveys is located at http://www.ak.nrcs.usda.gov/technical/soils/soilsurveys.html and soil maps and data are available online at http://websoilsurvey.nrcs.usda.gov/. Soil survey maps divide the landscape into areas called map units. The most detailed surveys in the state are mapped at a scale of 1:24,000. At this scale, the smallest soil areas delineated are about 5 acres (2 ha) in size. Several of the Alaska soil surveys are mapped at scales ranging from 1:63,360 to 1:250,000. The smallest areas delineated in these surveys range from 25–100 acres (10–40 ha) in size. Map units usually contain more than one soil type or component. They often contain several minor components or inclusions of soils with properties that may be similar to or quite different from the major component. Those soils that are hydric are noted in the *Hydric Soils List* published separately from the soil survey report. Soil survey information can be valuable for planning purposes, but it is not site-specific and does not preclude the need for an on-site investigation.

The *Exploratory Soil Survey of Alaska* provides coverage of the entire state at a scale of 1:1,000,000. The minimum size of areas delineated ranges from thousands to tens of thousands of acres. The *Exploratory Soil Survey of Alaska* provides a good overview of the major soil types in the various regions of the state. It does not provide any information for hydric soil determinations.

Hydric soils lists

Hydric soils lists are developed for each of the "detailed" or 1:24,000-scale soil surveys in Alaska. Using criteria approved by the NTCHS, these lists rate each soil component as either hydric or non-hydric based on soil property data. If the soil is rated as hydric, information is provided regarding which hydric criterion is met and on what landform the soil typically occurs. The hydric soils list should be used as a tool, indicating that hydric soil will likely be found within a given area. However, not all areas within a map unit or polygon identified as having hydric soils may be hydric.

The hydric soils lists available for individual 1:24,000 scale soil surveys are known as *Local Hydric Soil Lists.* They are available from NRCS offices and over the internet from the Soil Data Mart (http://soildatamart.nrcs.usda.gov/). Local Hydric Soils Lists have been compiled into a National Hydric Soils List available at http://soils.usda.gov/use/hydric/. However, use of Local Hydric Soils Lists is preferred since they are more current and reflect local variations in soil properties.

Hydric soil indicators

Many of the hydric soil indicators were developed specifically for wetland-delineation purposes. During the development of these indicators, soils in the interior of wetlands were not always examined; therefore, there are wetlands that lack any of the approved hydric soil indicators in their wettest interior portions. Wetland delineators and other users of the hydric soil indicators should concentrate their sampling efforts near the wetland edge and, if these soils are hydric, assume that soils in the interior of the wetland are also hydric even if they lack an indicator.

The following indicators are intended for use in all soils regardless of texture. Unless otherwise indicated, all mineral layers above any of the indicators must have a dominant chroma of 2 or less, or the layer(s) with dominant chroma of more than 2 must be less than 6 in. (15 cm) thick to meet any hydric soil indicator. Nodules and concretions are not considered to be redox concentrations unless otherwise noted.

Indicator A1: Histosol or Histel

Technical Description: Classifies as a Histosol (except Folists) or as a Histel (except Folistels).

User Notes: Histosols are soils usually having 16 in. (40 cm) or more of saturated organic material measured from the soil surface (Figure 8). Histels are simply Histosols that have permafrost in the soil profile, so some part of the organic material may be permanently frozen. Peak periods for observing saturation in each subregion are given below. Organic surfaces without evidence of saturation are excluded if not artificially drained (Folists and Folistels).

Figure 8. Example of a Histosol. This soil has saturated organic materials extending from the soil surface to a depth of more than 24 in. (60 cm). Scale is in centimeters.

The best evidence of saturation is the presence of a water table within the organic layer during at least part of the growing season. Saturation should be observable during peak periods within each subregion (see below) or may be inferred from wetland hydrology indicators outside of the peak period. Thin mineral strata may be observed within the organic layer. In some locations, ash deposits may overlie the organic material. These soils may or may not contain permafrost.

Aleutian Alaska. Saturation is likely to be observed throughout the year. Saturated organic deposits commonly occur in depressions and flats.

Interior Alaska. Saturation is most likely during May and late July—September. Saturated organic deposits commonly occur in groundwater discharge zones in depressions and flats and extensively across backslopes where restrictive layers (e.g., permafrost, glacial till) in the soil perch water.

Northern Alaska. Saturation is most likely during June–August. Saturated organic deposits commonly occur on coastal plains, in depressions, on slopes in the foothills, and on floodplains (Figure 9) where restrictive layers (e.g., permafrost, glacial till) in the soil perch water.

Figure 9. Soils with thick, saturated organic surfaces normally occur in concave or plain landform positions. Areas may range in size from very small depressions on backslopes to large fens and bogs. Usually a restrictive layer, such as glacial till or permafrost, impedes the downward movement of water.

Southcentral Alaska. Saturation is most likely to be observed during April–May and September–October. Saturated organic deposits commonly occur in groundwater discharge zones along toeslopes and footslopes where restrictive layers (e.g., glacial till) in the soil perch water. This indicator also occurs in depressions and along tidal fringes.

Southeast Alaska. Saturation is most likely to be observed during April–May and September–October. Saturated organic deposits commonly occur in groundwater discharge zones and where restrictive layers (e.g., bedrock, glacial till) in the soil perch water.

Western Alaska. Saturation is most likely during May–September. Saturated organic deposits commonly occur in groundwater discharge zones in depressions and flats, and extensively across backslopes where restrictive layers (e.g., permafrost, glacial till) in the soil perch water.

Indicator A2: Histic Epipedon

Technical Description: A histic epipedon underlain by mineral soil material with chroma of 2 or less.

User Notes: Most histic epipedons are surface horizons 8 in. (20 cm) or more thick of saturated organic material (Figure 10). The intent of this indicator is to identify saturated organic accumulations generally 8 to 16 in. (20–40 cm) thick that are not as thick as those described in Indicator A1 (Histosol or Histel). A histic epipedon must be saturated in all or part of the layer at some time in most years. The best evidence of saturation is the presence of a water table during at least part of the growing season. Saturation should be observable during peak periods within each subregion (see Indicator A1) or may be inferred from wetland hydrology indicators outside of the peak period.

Figure 10. A histic epipedon consisting of saturated organic material overlying mineral soil. In this example, the saturated organic material extends from the soil surface to a depth of approximately 10 in. (25 cm).

Thin mineral strata may be observed within the organic layers. In some locations, ash deposits may overlie the organic material. These soils may or may not contain permafrost. Organic surfaces without evidence of saturation are excluded if not artificially drained.

Indicator A4: Hydrogen Sulfide

Technical Description: A hydrogen sulfide odor within 12 in. (30 cm) of the soil surface.

User Notes: These soils are usually permanently saturated and anaerobic at or near the surface. Any time the excavated soil smells of hydrogen sulfide (rotten egg odor), sulfur is currently being reduced and the soil is definitely in an anaerobic state. In some soils, the odor is well pronounced; in others, it is very fleeting as the gas dissipates rapidly. If in doubt, quickly open several small holes in the area of concern to determine if a hydrogen sulfide odor is present.

Indicator A12: Thick Dark Surface

Technical Description: A layer at least 6 in. (15 cm) thick with a depleted or gleyed matrix that has 60 percent or more chroma of 2 or less starting below 12 in. (30 cm) of the surface. The layer(s) above the depleted or gleyed matrix must have a value of 2.5 or less and a chroma of 1 or less to a depth of at least 12 in. (30 cm) and value of 3 or less and chroma of 1 or less in any remaining layers above the depleted or gleyed matrix. Any sandy material above the depleted or gleyed matrix must have at least 70 percent of the visible soil particles covered, coated, or similarly masked with organic material.

User Notes: Accumulation of organic carbon in mineral soil layers results in dark colors. Thicker dark surfaces are common in depressional areas where moisture accumulates and plant growth is enhanced. The thicker dark surfaces do not necessarily indicate saturation. However, if saturation does occur, the thick dark surface may mask or hide evidence of reduction near the soil surface. Look for two things. One is evidence of a depleted or gleyed matrix below the dark surface material (see the Glossary for definitions of depleted and gleyed matrix). The other is a source of saturation. This may include a restrictive layer that perches precipitation and snowmelt, a nearby spring or seep, or a snowfield that persists late into the summer (see Indicator TA5 – Alaska Alpine Swales).

Use of this indicator requires close observation and an understanding of landform position and local sources of hydrology.

This indicator is used for soils with thick, very dark surface mineral horizons that mask reduction features (Figure 11). Visible evidence of gley may only be observable deeper in the soil. Look below 12 in. (30 cm) for evidence of a depleted or gleyed matrix.

Figure 11. A depleted matrix begins at approximately 14 in. (35 cm) below a dark surface mineral layer. Scale is in centimeters.

Since some soils with thick dark surfaces are Spodosols, extreme care must be taken not to confuse grayish colored E horizon material with depleted colors. In addition, glacial deposits or marine sediments underlie some Alaska soils. These parent materials have base colors that can easily be confused with gleyed colors. Look for redox concentrations along root channels and other soil pores (see Indicator A14 – Alaska Redox) and/or gleyed root channels (see Indicator A15 – Alaska Gleyed Pores) below 12 in. (30 cm).

Aleutian Alaska. This indicator is not known to occur in the subregion.

Interior Alaska. Saturation is most likely to be observed during April–May and September–October. This is a common indicator on mountain slopes where restrictive layers in the soil perch seasonal water tables. This indicator does not occur in permafrost-affected soils.

Northern Alaska. Saturation is most likely to be observed during June–August. This is a common indicator on mountain slopes where restrictive layers in the soil perch seasonal water tables.

Southcentral Alaska. Saturation is most likely to be observed during April–May and September–October. This is a common indicator on mountain slopes where restrictive layers in the soil perch seasonal water tables.

Southeast Alaska. This indicator is not known to occur in the subregion.

Western Alaska. Saturation is most likely to be observed during April–May and September–October. This is a common indicator on mountain slopes where restrictive layers in the soil perch seasonal water tables. This indicator does not occur in permafrost-affected soils.

Indicator A13: Alaska Gleyed

Technical Description: A mineral layer with a dominant hue of N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB and with a value of 4 or more (i.e., a gleyed matrix) in more than 50 percent of the matrix. The layer starts within 12 in. (30 cm) of the mineral surface and is underlain within 60 in. (1.5 m) by soil material with hue of 5Y or redder in the same type of parent material.

User Notes: This indicator has two requirements. First, within 12 in. (30 cm) of the soil surface, a layer having one or more of the specified gleyed colors is present. These colors can be found on the gleyed 1 and gleyed 2 pages of the Munsell color book (Gretag/Macbeth 2000) (see Figure A2). Second, below these gleyed colors, the color of similar soil material is hue 5Y or redder (i.e., 2.5Y, 10YR, 7.5YR, etc.). If the gleyed colors extend beyond a depth of 60 in. (1.5 m), the true color of the parent material cannot be determined. In that case, try applying Indicator A14 (Alaska Redox). The presence of gleyed colors indicates that the soil has undergone reduction. The requirement for 5Y or redder colors lower in the profile is to ensure that the gleyed colors are not simply the basic color of the soil parent material. This indicator proves that the near-surface gleyed colors are not natural soil material colors, and that they are the result of reduced conditions. When comparing near-surface and underlying colors, make sure that the type of soil material is the same (Figures 12 and 13). Many soils in Alaska are composed of two or more types of material (e.g., silty loess overlying gravelly glacial till or sand-and-gravel river deposits).

Figure 12. The bluish color of the soil material on the left (from the upper portion of the soil profile) indicates reduced conditions. The dark color of the soil material on the right (from lower in the same soil profile) is the color of the parent material and not the result of saturation.

Tidal sediments, lacustrine sediments, loess, and some glacial tills have base colors that appear as gleyed. On closer examination, their colors will normally not fit on the gley color pages. Information specific to each subregion follows:

Aleutian Alaska. This indicator is commonly found in tidal flats and estuaries, and upland depressions. It may be difficult to apply due to predominance of volcanic ash.

Interior Alaska. This indicator is commonly found along transition zones between fens and bogs and adjacent uplands, in groundwater discharge areas, and depressional areas within low floodplains. Saturation may be the result of a local riparian water table or water perched on restrictive layers, especially permafrost, within the soil.

Northern Alaska. This indicator is commonly found in depressions on floodplains, tidal flats, and foothills, and drainage channels on foothills. Saturation may be a result of local riparian water tables or water perched on permafrost.

Figure 13. The bluish band between 4 and 8 in. (10–20 cm) indicates the presence of reduced soil material. The underlying material below 8 in. (20 cm) reflects both the color of the parent material and soil weathering under aerobic conditions. Scale is in centimeters.

Southcentral Alaska. This indicator is commonly found along transition zones between fens and bogs and adjacent uplands, groundwater discharge areas, and depressional areas within low floodplains. Saturation may be the result of a local riparian water table or water perched on restrictive layers within the soil.

Southeast Alaska. This indicator is commonly found along hill and mountain slopes. Saturation is usually the result of water perched on glacial till.

Western Alaska. This indicator is commonly found along transition zones between fens or bogs and the adjacent uplands, in groundwater discharge areas, and broad depressional areas within low floodplains and in deltaic areas. Saturation may be the result of a local riparian water table or water perched on restrictive layers, including permafrost, within the soil.

Indicator A14: Alaska Redox

Technical Description: A mineral layer that has a dominant hue of 5Y with a chroma of 3 or less, or a gleyed matrix, with 10 percent or more distinct or prominent redox concentrations occurring as pore linings with a value and chroma of 4 or more. The layer starts within 12 in. (30 cm) of the soil surface.

User Notes: These soils have a layer within 12 in. (30 cm) of the mineral surface that meets the specified color requirements. See the Glossary for the definition of gleyed matrix. These colors can be found on the 5Y page or the gleyed 1 or gleyed 2 pages of the Munsell soil color book (Gretag/Macbeth 2000). The layer must also contain at least 10 percent by volume redox concentrations (reddish-orange iron coatings) along pores (Figure 14). Redox concentrations are required to prove that the gleyed colors are not parent material colors.

Figure 14. The matrix color meets the requirements of a gleyed matrix. Reddish-orange redox concentrations occur along root channels and other pores.

In soils that have been reduced, one of the first areas where oxygen will be reintroduced is along root channels and other pores. As oxidation occurs in these areas, characteristic reddish-orange redox concentrations (value and chroma of 4 or more) form. These concentrations stand out in contrast to the matrix color of the soil layer.

When applying this indicator, first note the dominant color(s) of the soil layer to see if it matches the colors indicated. Then break open pieces of the soil and look for reddish-orange redox concentrations along pores and root channels (Figures 15 and 16). If these features are present, it indicates that the soil has been reduced during periods of wetness and, while in a drier state, has undergone oxidation.

Aleutian Alaska. This indicator is commonly found in tidal flats and upland depressions. Identification may be difficult due to the predominance of volcanic ash.

Interior Alaska. This indicator is commonly found on most landforms. Saturation may be the result of fluctuating water tables in riparian zones or fluctuating water tables perched on slowly permeable materials, especially permafrost.

Figure 15. Gleyed matrix colors and reddish-orange iron concentrations. Concentrations are along root channels.

Figure 16. Gleyed matrix color and redox concentrations surrounding root channels. Scale is in centimeters.

Northern Alaska. This indicator is commonly found along foothills and micro-high positions (patterned ground) on coastal plains. Saturation is usually the result of a fluctuating water table perched on seasonal frost or permafrost.

Southcentral Alaska. This indicator is commonly found in depressions on most landforms. Saturation may be the result of fluctuating water tables in riparian zones or fluctuating water tables perched on slowly permeable sediments.

Southeast Alaska. This indicator is commonly found near uplifted beaches and estuaries with loamy glaciofluvial parent materials. Saturation is usually the result of a fluctuating water table perched on slowly permeable sediments.

Western Alaska. This indicator is commonly found on most landforms. Saturation may be the result of fluctuating water tables in riparian zones or fluctuating water tables perched on slowly permeable materials.

Indicator A15: Alaska Gleyed Pores

Technical Description: A mineral layer that has 10 percent or more hue of N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value of 4 or more along root channels or other pores and that starts within 12 in. (30 cm) of the soil surface. The matrix has a dominant hue of 5Y or redder.

User Notes: This indicator is intended to look for subtle evidence of active reduction in a soil. Due to the presence of organic carbon along root channels, visible evidence of reduction will first occur there (Figure 17). The evidence is thin coatings meeting the specified color requirements. These colors can be found on the gleyed 1 and gleyed 2 pages of the Munsell soil color book (Gretag/Macbeth 2000) (see Figure A2). Care must be taken to observe all of the color variations in the soil and not just the dominant soil color. Break pieces of soil open and closely look along the root channels. Many of these will be very thin or fine. A hand lens may be helpful.

In a soil layer that is turning anaerobic, reduced conditions occur first where the soil microbes have an ample supply of organic carbon. Colder soils, as in Alaska, normally have low organic carbon, so microbes congregate along channels containing dead roots. It is along these channels that gley colors first appear.

Aleutian Alaska. This indicator is commonly found in tidal flats and upland depressions. It may be difficult to apply due to predominance of volcanic ash.

Interior Alaska. This indicator is commonly found in riparian areas and in depressions on most landforms where water tables perch on slowly permeable sediments, primarily permafrost. Where water tables fluctuate, redox concentrations may also be present.

Northern Alaska. This indicator is commonly found along floodplains subject to fluctuating water tables and/or ponding.

Southcentral Alaska. This indicator is commonly found in riparian areas and in depressions on most landforms where water tables perch on slowly permeable sediments. Where water tables fluctuate, redox concentrations may also be present.

Figure 17. Reduction occurs first along root channels where organic carbon is concentrated. Note gleyed colors along root channels.

Southeast Alaska. This indicator may occur in any saturated mineral soil and may be found across all landforms.

Western Alaska. This indicator is commonly found in riparian areas and in depressions on most landforms where water tables perch on slowly permeable material. Where water tables fluctuate, redox concentrations may also be present.

Hydric soil indicators for problem soils

The following indicators are not currently recognized for general application by the NTCHS and are intended for use only in problem wetland situations in Alaska that have evidence of wetland hydrology and hydrophytic vegetation, and are believed to meet the definition of a hydric soil, but lack recognized indicators of a hydric soil. To use these indicators, follow the procedure described in the section on Problematic Hydric Soils in Chapter 5. If any of the following indicators is observed, it is recommended that the NTCHS be notified by following the protocol described in the “Comment on the Indicators” section of *Field Indicators of Hydric Soils in the United States* (USDA Natural Resources Conservation Service 2006).

Indicator TA4: Alaska Color Change

Technical Description: A mineral layer 4 in. (10 cm) or more thick starting within 12 in. (30 cm) of the surface that has a matrix value of 4 or more and chroma of 2 or less and that within 30 minutes becomes redder by one or more Munsell unit in hue and/or chroma when exposed to air.

User Notes: The soil should be at or near saturation when examined. If the soil matrix is sufficiently reduced and has gley colors, reduced iron (Fe^{+2}) in the soil can begin to oxidize (Fe^{+3}) upon exposure to the air (Figures 18 and 19). Care must be taken to obtain an accurate color of the soil sample immediately upon excavation. The colors should be examined again after several minutes. Do not allow the sample to begin drying, as drying will also result in a color change. Care must be taken to observe the colors closely. As always, do not obtain colors while wearing sunglasses. Colors must be obtained in the field under natural light and not under artificial light. Look for the presence of other indicators.

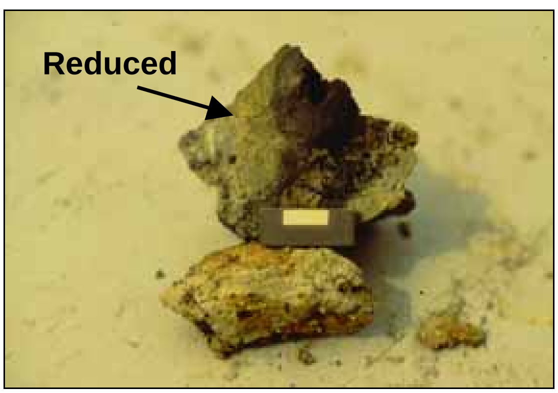

Figure 18. This soil exhibits colors associated with reducing conditions. Scale is 1 cm.

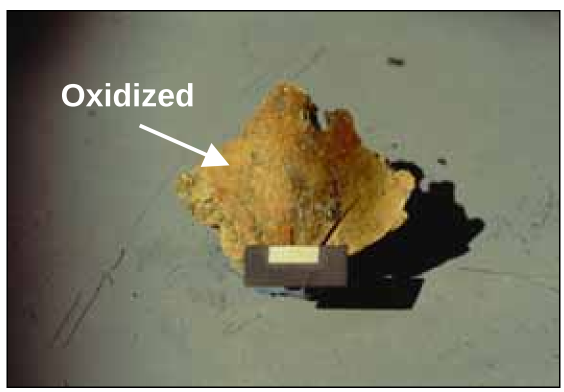

Figure 19. The same soil as in Figure 18 after exposure to the air and oxidation has occurred.

Aleutian Alaska. Saturation is likely to be observed throughout the year.

Interior Alaska. Saturation is most likely during May and late July–September.

Northern Alaska. Saturation is most likely during June–August.

Southcentral Alaska. Saturation is most likely during April–May and September–October.

Southeast Alaska. Saturation is most likely during April–May and September–October.

Western Alaska. Saturation is most likely during May–September.

Indicator TA5: Alaska Alpine Swales

Technical Description: On concave landforms, the presence of a surface mineral layer 4 in. (10 cm) or more thick having hue of 10YR or yellower, value of 2.5 or less, and chroma of 2 or less. The dark surface layer is at least twice as thick as the mineral surface layer of soils in the adjacent convex micro-positions.

User Notes: Soils with this indicator occur in concave positions in alpine and subalpine areas where moisture accumulates (Figure 20). Here the source of hydrology is melt water from the adjacent snowpack that persists well into the growing season. The landscape is usually a complex micro-topography of concave depressions and adjacent micro-highs. Soils should be examined in both landscape positions and compared. If both positions have a mineral surface of the same color, but the layer is at least twice as thick in the concave position, the soil in the concave position is considered hydric. Make sure that there is reasonable evidence of the hydrology source. This includes either direct observation of the melting snowpack or aerial imagery that shows snowpack at that location earlier in the growing season.

Aleutian Alaska. This indicator is not known to occur in this subregion.

Interior Alaska. Saturation is most likely to be observed during late May through early July. This is a common indicator in concave micro-positions on mountain slopes and plains where snow accumulates during the winter.

Northern Alaska. Saturation is most likely to be observed during late May through mid-July. This is a common indicator in concave micro-positions on mountain slopes and plains where snow accumulates during the winter.

Figure 20. The arrows indicate concave micro-positions where water from snowmelt accumulates during late spring and early summer.

Southcentral Alaska. Saturation is most likely to be observed during late May through early July. This is a common indicator in concave micro-positions on mountain slopes and plains where snow accumulates during the winter.

Southeast Alaska. This indicator is unknown in this subregion, but may exist in alpine areas.

Western Alaska. Saturation is most likely to be observed during late May through June. This is a common indicator in concave micro-positions on mountain slopes and plains where snow accumulates during the winter.

Indicator: Alaska Redox with 2.5Y Hue

Technical Description: A mineral layer that has a dominant hue of 2.5Y with a chroma of 3 or less, with 10 percent or more distinct or prominent redox concentrations occurring as pore linings with a value and chroma of 4 or more. The layer starts within 12 in. (30 cm) of the soil surface.

User Notes: Hue of 2.5Y is excluded from the Alaska Redox indicator (A14). This is to avoid confusion with non-hydric soils that have a hue of 2.5Y resulting from the color of the parent material and contain relict redox concentrations. Examples include soils formed in glacial tills and loess, especially if they were affected by seasonal frost or permafrost in the past. There are, however, areas where a hue of 2.5Y, chroma of 3 or less, and the presence of redox concentrations do indicate a hydric soil. For example, such soils are often found on the fringes of wetlands as they transition to upland areas.

Indicator: Alaska Gleyed without Hue 5Y or Redder Underlying Layer

Technical Description: A mineral layer with a dominant hue of N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB and with value of 4 or more (a gleyed matrix) in more than 50 percent of the matrix. The layer starts within 12 in. (30 cm) of the mineral surface.

User Notes: Alaska Gleyed (A13) requires that the gleyed zone be underlain by similar soil material having a hue of 5Y or redder. This requirement is intended to eliminate confusion with non-hydric soils that have parent material colors similar to gleyed colors. There are areas, however, where continuously saturated conditions result in gleyed colors that are present to considerable depth in the soil profile. Such soils are continuously reduced and lack redox concentrations. See the Glossary for the definition of a gleyed matrix.

4 Wetland Hydrology Indicators

Introduction

Wetland hydrology indicators are used in combination with indicators of hydric soil and hydrophytic vegetation to determine whether an area is a wetland under the Corps Manual. Indicators of hydrophytic vegetation and hydric soil generally reflect a site's medium- to long-term wetness history. They provide readily observable evidence that episodes of inundation or soil saturation lasting more than a few days during the growing season have occurred repeatedly over a period of years and that the timing, duration, and frequency of wet conditions have been sufficient to produce a characteristic wetland plant community and hydric soil morphology. If hydrology has not been altered, vegetation and soils provide the strongest evidence that wetland hydrology is present (National Research Council 1995). Wetland hydrology indicators provide evidence that the site has a *continuing* wetland hydrologic regime and that hydric soils and hydrophytic vegetation are not relicts of a past hydrologic regime. Wetland hydrology indicators confirm that an episode of inundation or soil saturation occurred recently, but may provide little additional information about the timing, duration, or frequency of such events (National Research Council 1995).

Hydrology indicators are the most ephemeral of wetland indicators. Those involving direct observation of surface water or saturated soils are often present only during the normal wet portion of the growing season and may be absent during the dry season or during drier-than-normal years. On the other hand, some indicators may be present on non-wetland sites during spring break-up, immediately after a heavy rain, or during a period of unusually high precipitation, river stages, runoff, or snowmelt. Normal seasonal variations in rainfall, temperature, and other climatic conditions should always be considered in interpreting hydrology indicators. Hydrology indicators help to confirm the presence of a continuing wetland hydrologic regime; however, the lack of an indicator is not evidence for the absence of wetland hydrology. Wetland situations that may lack hydrology indicators are discussed further in Chapter 5 (Difficult Wetland Situations in Alaska).

Areas that have hydrophytic vegetation and hydric soils generally also have wetland hydrology unless the hydrologic regime has changed due to natural events or human activities (National Research Council 1995). Therefore, when wetland hydrology indicators are absent from an area that has hydric soils and hydrophytic vegetation, additional information may be needed to determine whether or not wetland hydrology is present. If the original site visit was made during the dry season or a drier-than-normal year, it may be necessary to revisit the site during the wet season or in a normal year and check again for hydrology indicators. In addition, aerial photography or remote sensing data, stream gauge data, runoff estimates, scope-and-effect equations for ditches and subsurface drain lines, or groundwater modeling are tools that may help to determine whether wetland hydrology is present when indicators are equivocal or lacking (e.g., USDA Natural Resources Conservation Service 1997). Finally, on highly disturbed or problematic sites, direct hydrologic monitoring may be needed. The U. S. Army Corps of Engineers (2005) provides a technical standard for monitoring hydrology on such sites. This standard requires 14 or more consecutive days of flooding or ponding, or a water table 12 in. (30 cm) or less below the soil surface, during the growing season at a minimum frequency of 5 years in 10 (50 percent or higher probability) (National Research Council 1995) unless an alternative standard has been established for a particular region or wetland type. See Chapter 5 for further information on these techniques.

Growing season

Beginning and ending dates of the growing season are needed to evaluate certain wetland hydrology indicators, such as visual observations of flooding, ponding, or shallow water tables on potential wetland sites. In addition, growing season dates are needed in the event that recorded hydrologic data, such as stream gauge or water-table monitoring data, must be analyzed to determine whether wetland hydrology is present on highly disturbed or problematic sites.

In the absence of locally or regionally developed methods to determine growing season dates, the U.S. Army Corps of Engineers (2005) suggests a procedure based on the median dates (i.e., 5 years in 10, or 50 percent probability) of 28 °F (-2.2 °C) air temperatures in spring and fall, based on long-term records gathered at National Weather Service meteorological stations and reported in WETS tables by the NRCS National Water and Climate Center (http://www.wcc.nrcs.usda.gov/climate/wetlands.html). However, this approach is often impractical in Alaska due to the scarcity of meteorological stations and differences in elevation, aspect, and other conditions between project sites and the locations of existing weather stations.

Depletion of oxygen and the chemical reduction of nitrogen, iron, and other elements in saturated soils is the result of biological activity occurring in plant roots and soil microbial populations (National Research Council 1995). Therefore, in Alaska, the preferred approach to determine growing season dates involves direct observation of vegetation green-up, growth, and maintenance as an indicator of biological activity occurring both above and below ground. Two alternative procedures to evaluate vegetation activity are given below. The first, based on observations made during one or more site visits, is preferred when data are available. The second, based on remote-sensing data gathered during the 1990s for broad ecoregions in Alaska, may be used in the absence of site-specific and year-specific information. Growing season determinations are subject to review and approval by the Corps of Engineers Alaska District.

1. The growing season has begun on a site in a given year when two or more different non-evergreen vascular plant species growing in the wetland or surrounding areas exhibit one or more of the following indicators of biological activity:
   a. Emergence of herbaceous plants from the ground
   b. Appearance of new growth from vegetative crowns (e.g., in graminoids, bulbs, and corms)
   c. Coleoptile/cotyledon emergence from seed
   d. Bud burst on woody plants (i.e., some green foliage is visible between spreading scales)
   e. Emergence or elongation of leaves of woody plants
   f. Emergence or opening of flowers

   The end of the growing season is indicated when woody deciduous species lose their leaves and/or the last herbaceous plants cease flowering and their leaves become dry or brown, generally in the fall due to cold temperatures or reduced moisture availability. Early plant senescence due to the initiation of the summer dry season in some areas does not necessarily indicate the end of the growing season and alternative procedures should be used (see item 2 below).

This determination should not include evergreen species. Observations should be made in the wetland or in surrounding areas subject to the same climatic conditions (e.g., similar elevation and aspect); however, soil moisture conditions may differ. Supporting data should be reported on the data form, in field notes, or in the delineation report, and should include the species observed (if identifiable), their abundance and location relative to the potential wetland, and type of biological activity observed. A one-time observation of biological activity during a single site visit is sufficient, but is not required unless growing season information is necessary to evaluate particular wetland hydrology indicators. However, if long-term hydrologic monitoring is planned, then plant growth, maintenance, and senescence should be monitored for continuity over the same period. If appropriate, the observed growing season dates should be discussed in relation to the median dates of vegetation green-up and senescence as described in item 2 below, or in relation to the median dates of 28 °F air temperatures in spring and fall as reported in WETS tables for the nearest appropriate weather station.

2. Growing season dates for broad areas can be estimated by calculating the median dates of the onset of vegetation green-up in spring and of vegetation senescence in fall using a normalized difference vegetation index (NDVI) derived from very high resolution radiometer measurements as described by Markon (2001) (http://agdcftp1.wr.usgs.gov/pub/projects/lcc/ak_avhrr/pheno_ofr_final.pdf). For each of 20 ecoregions in Alaska (Figure 21), Markon (2001) reported the Julian dates of initial vegetation green-up ("Minday") and senescence ("Lastday") for each year from 1991 to 1997. The medians of these annual values (Table 5) may be used to estimate growing season beginning and ending dates when on-site observations of vegetation growth and development are not available.

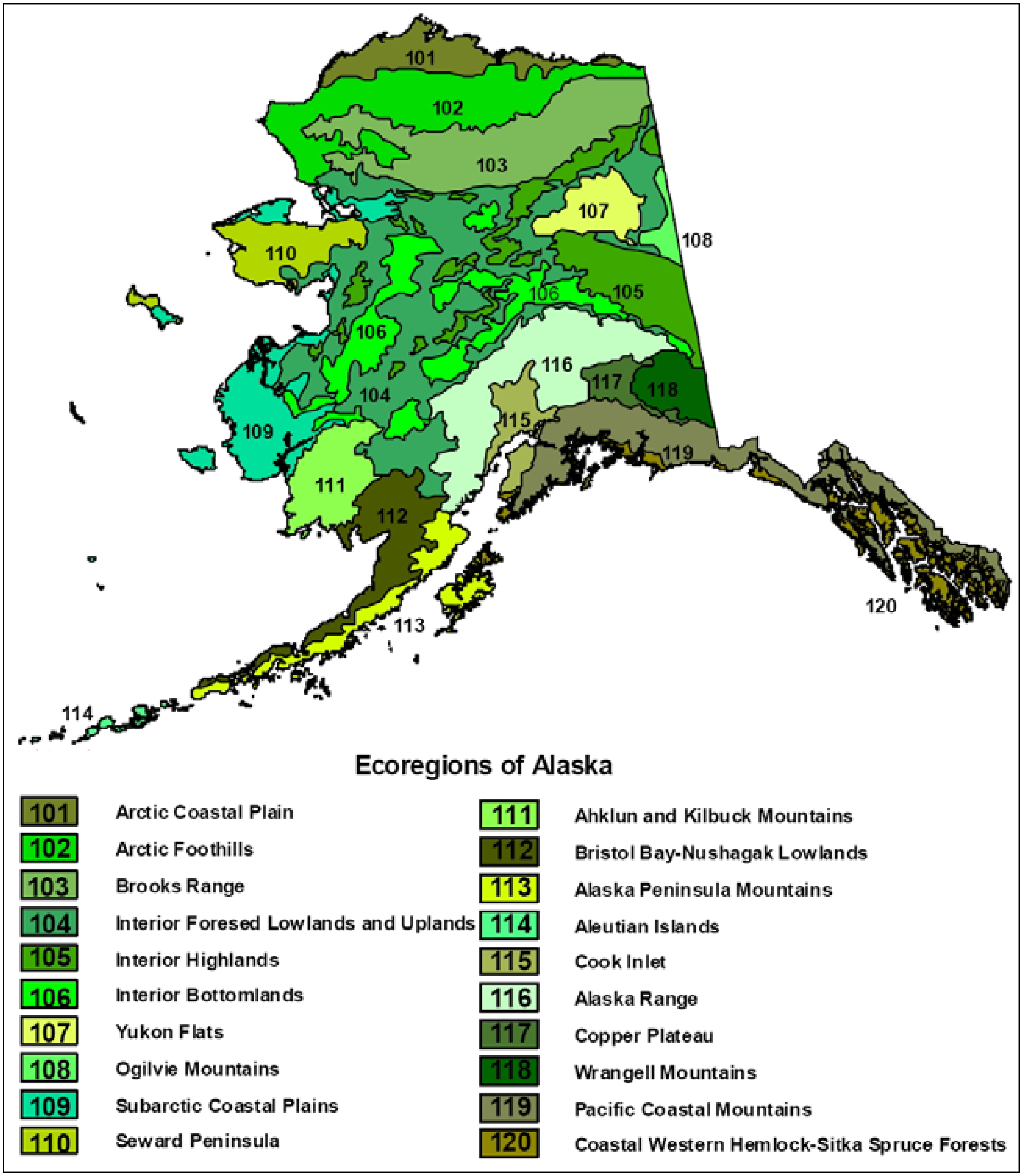

Figure 21. Ecoregions of Alaska, from Markon (2001).

Table 5. Median beginning and ending dates of the growing season for ecoregions in Alaska, derived from Markon (2001).

Ecoregion[1]	Beginning of Growing Season (‘Minday’)		End of Growing Season (‘Lastday’)	
	Julian Date	Calendar Date[2]	Julian Date	Calendar Date[2]
101 Arctic Coastal Plain	171	Jun 20	261	Sep 18
102 Arctic Foothills	158	Jun 7	264	Sep 21
103 Brooks Range	150	May 30	267	Sep 24
104 Interior Forested Lowlands and Uplands	123	May 3	276	Oct 3
105 Interior Highlands	124	May 4	275	Oct 2
106 Interior Bottomlands	122	May 2	277	Oct 4
107 Yukon Flats	110	Apr 20	276	Oct 3
108 Ogilvie Mountains	110	Apr 20	276	Oct 3
109 Subarctic Coastal Plains	143	May 23	276	Oct 3
110 Seward Peninsula	153	Jun 2	274	Oct 1
111 Ahklun and Kilbuck Mountains	136	May 16	275	Oct 2
112 Bristol Bay – Nushagak Lowlands	115	Apr 25	277	Oct 4
113 Alaska Peninsula Mountains	135	May 15	274	Oct 1
114 Aleutian Islands	--[3]	--[3]	--[3]	--[3]
115 Cook Inlet	128	May 8	278	Oct 5
116 Alaska Range	144	May 24	276	Oct 3
117 Copper Plateau	122	May 2	276	Oct 3
118 Wrangell Mountains	131	May 11	272	Sep 29
119 Pacific Coastal Mountains[4]	149	May 29	270	Sep 27
120 Coastal Western Hemlock – Sitka Spruce Forests[4]	119	Apr 29	271	Sep 28

[1] See Figure 21.

[2] Calendar dates shown are for non-leap years. For a leap year, subtract one day (e.g., for Ecoregion 101, the growing season would begin on June 19 in a leap year).

[3] There were no data available for Ecoregion 114 – Aleutian Islands. Growing season dates for Ecoregion 112 may be substituted when onsite data are lacking.

[4] Ecoregions 119 and 120 are intermingled in Southeast Alaska. Generally, 1,600 ft (500 m) in elevation separates the two ecoregions. Use growing season dates for Ecoregion 119 above 1,600 ft elevation and dates for Ecoregion 120 below 1,600 ft elevation. Annual variability may occur as the snow recedes from lower elevations at different rates.

Wetland hydrology indicators

In this chapter, wetland hydrology indicators are presented in four groups. Indicators in Group A are based on the direct observation of surface water or groundwater during a site visit. Group B consists of evidence that the site was flooded or ponded recently, although the site may not be inundated currently. These indicators include water marks, drift deposits, sediment deposits, and similar features. Group C consists of other evidence that the soil is saturated currently or was saturated recently. Some of these indicators, such as oxidized rhizospheres surrounding living roots or the presence of reduced iron in the profile, indicate that the soil has been saturated for an extended period. Group D consists of landscape characteristics and vegetation and soil features that indicate contemporary rather than historical wet conditions. Wetland hydrology indicators are intended as one-time observations of site conditions that are sufficient evidence of wetland hydrology in areas where hydric soils and hydrophytic vegetation are present.

Within each group, indicators are divided into two categories – *primary* and *secondary* – based on their estimated reliability in the region. One primary indicator from any group is sufficient to conclude that wetland hydrology is present; the area is a wetland if indicators of hydric soil and hydrophytic vegetation are also present. In the absence of a primary indicator, two or more secondary indicators from any group are required to conclude that wetland hydrology is present. Indicators of wetland hydrology include, but are not necessarily limited to, those listed in Table 6 and described on the following pages. Other evidence of wetland hydrology may also be used with appropriate documentation.

In this supplement, wetland hydrology indicators that have depth requirements (e.g., Indicator A2 – High Water Table) are evaluated from the mineral soil surface or the top of any organic soil layer, whichever is shallower. Organic layers consist of dead and decomposing plant matter, excluding freshly fallen plant litter, and do not include any living material (e.g., a living mat of mosses, lichens, etc.). The organic layer, if present, can be either saturated or unsaturated and of any thickness. Therefore, on some sites, the surface for hydric soil determinations (see Chapter 3) and wetland hydrology determinations may differ.

Table 6. List of wetland hydrology indicators for Alaska.

Indicator	Category	
	Primary	Secondary
Group A – Observation of Surface Water or Saturated Soils		
A1 – Surface water	X	
A2 – High water table	X	
A3 – Saturation	X	
Group B – Evidence of Recent Inundation		
B1 – Water marks	X	
B2 – Sediment deposits	X	
B3 – Drift deposits	X	
B4 – Algal mat or crust	X	
B5 – Iron deposits	X	
B6 – Surface soil cracks	X	
B7 – Inundation visible on aerial imagery	X	
B8 – Sparsely vegetated concave surface	X	
B15 – Marl deposits	X	
B9 – Water-stained leaves		X
B10 – Drainage patterns		X
Group C – Evidence of Current or Recent Soil Saturation		
C1 – Hydrogen sulfide odor	X	
C2 – Dry-season water table	X	
C3 – Oxidized rhizospheres along living roots		X
C4 – Presence of reduced iron		X
C5 – Salt deposits		X
Group D – Evidence from Other Site Conditions or Data		
D1 – Stunted or stressed plants		X
D2 – Geomorphic position		X
D3 – Shallow aquitard		X
D4 – Microtopographic relief		X
D5 – FAC-neutral test		X

Group A – Observation of Surface Water or Saturated Soils

Indicator A1: Surface water

Category: Primary

General Description: This indicator consists of the direct, visual observation of surface water (flooding or ponding) during a site visit (Figure 22).

Figure 22. Wetland with surface water present.

Cautions and User Notes: Care must be used in applying this indicator because surface water may be present in non-wetland areas immediately after a rainfall event, during spring break-up, or during periods of unusually high precipitation, runoff, tides, or river stages. Surface water observed during the non-growing season may be an acceptable indicator if experience and professional judgment suggest that wet conditions normally extend into the growing season for sufficient duration in most years. Surface water may be absent from a wetland during the normal dry season or during periods of drought. Even under normal rainfall conditions, some wetlands do not become inundated or saturated every year (i.e., wetlands are inundated or saturated at least 5 out of 10 years, or 50 percent or higher probability in a given year). In addition, inundation may be infrequent, brief, or entirely lacking in groundwater-dominated wetland systems.

Indicator A2: High water table

Category: Primary

General Description: This indicator consists of the direct, visual observation of the water table 12 in. (30 cm) or less below the surface in a soil pit, auger or probe hole, or shallow monitoring well (Figure 23).

Figure 23. High water table observed in a soil pit.

Cautions and User Notes: Sufficient time must be allowed for water to infiltrate into a newly dug hole and to stabilize at the water-table level. The required time will vary depending upon soil texture. In some cases, the water table can be determined by examining the wall of the soil pit and identifying the upper level at which water is seeping into the pit. A water table within 12 in. of the surface observed during the non-growing season may be an acceptable indicator if experience and professional judgment suggest that wet conditions normally extend into the growing season for sufficient duration in most years. If this is questionable and other hydrology indicators are absent, a follow-up visit during the growing season may be needed. Care must be used in interpreting this indicator because water-table levels normally vary seasonally and are a function of both recent and long-term precipitation and seasonal frost conditions. Even under normal rainfall conditions, some wetlands do not become inundated or saturated every year (i.e., wetlands are inundated or saturated at least 5 out of 10 years, or 50 percent or higher probability in a given year). For an accurate determination of the water-table level, the soil pit, auger hole, or well should not penetrate any restrictive soil layer capable of perching water near the surface.

Indicator A3: Saturation

Category: Primary

General Description: Visual observation of saturated soil conditions 12 in. (30 cm) or less from the soil surface as indicated by water glistening on the surfaces and broken interior faces of soil samples removed from the pit or auger hole (Figure 24). This indicator must be associated with an existing water table located immediately below the saturated zone; however, this requirement is waived under episaturated conditions if there is a restrictive soil layer or bedrock within 12 in. (30 cm) of the surface.

Figure 24. Water glistens on the surface of a saturated soil sample.

Cautions and User Notes: Glistening is evidence that the soil sample was taken either below the water table or within the saturated capillary fringe above the water table. Recent rainfall events and the proximity of the water table at the time of sampling should be considered in applying and interpreting this indicator. Water observed in soil cracks or on the faces of soil aggregates (peds) does not meet this indicator unless ped interiors are also saturated. Examine both the walls of the soil pit (Figure 25) and material removed from the pit for evidence of saturation. Samples should not be shaken or squeezed to force water from soil pore spaces. A water table is not required below the saturated zone under episaturated conditions if the restrictive layer or bedrock is present within 12 in. (30 cm) of the surface. Note the restrictive layer in the soils section of the data form. The restrictive layer may be at the surface.

Figure 25. Water glistens on the walls of a soil pit.

Group B – Evidence of Recent Inundation

Indicator B1: Water marks

Category: Primary

General Description: Water marks are discolorations or stains on bark of woody vegetation, rocks, bridge pillars, buildings, fences, or other fixed objects as a result of inundation (Figures 26 and 27).

Cautions and User Notes: When several water marks are present, the highest reflects the maximum extent of inundation. Water marks indicate a water-level elevation and can be extrapolated from nearby objects across lower elevation areas. Use caution with water marks that may have been caused by extreme or infrequent flooding events or by brief, temporary flooding during the spring break-up period.

Figure 26. Water marks (dark stains) on a boulder (upper edge indicated by the arrow).

Figure 27. Water marks on paper birch.

Indicator B2: Sediment deposits

Category: Primary

General Description: Sediment deposits are thin layers or coatings of fine-grained mineral material (e.g., silt or clay) or organic matter (e.g., pollen), sometimes mixed with other detritus, remaining on plant stems or leaves, rocks, and other objects after surface water recedes (Figure 28).

Cautions and User Notes: Sediment deposits may remain for a considerable period before being removed by precipitation or subsequent inundation. Sediment deposits on vegetation or other objects indicate the minimum inundation level. This level can be extrapolated across lower elevation areas. Use caution with sediment left after infrequent high flows or very brief flooding events. This indicator does not include thick accumulations of sand or gravel in or adjacent to fluvial channels that may reflect historic flow conditions or recent extreme events. Use caution in areas where silt and other material trapped in the snowpack may be deposited directly on the ground surface during spring thaw.

Figure 28. Deposits of gray sediment on sedges in a tidal channel.

Indicator B3: Drift deposits

Category: Primary

General Description: Drift deposits consist of rafted debris that has been deposited on the ground surface or entangled in vegetation or other fixed objects. Debris consists of remnants of vegetation (e.g., branches, stems, and leaves), man-made litter, or other waterborne materials. Drift material may be deposited at or near the high water line in ponded or flooded areas, piled against the upstream side of trees, rocks, and other fixed objects, or widely distributed within the dewatered area (Figure 29).

Cautions and User Notes: Deposits of drift material are often found adjacent to streams or other sources of flowing water in wetlands. They also occur in tidal marshes, along lake shores, and in other ponded areas.

Figure 29. Drift deposit of leaves in a seasonally ponded wetland.

Drift lines indicate the minimum water level attained during a flooding event; the maximum level of inundation is generally higher than that indicated by a drift line. The elevation of a drift line can be extrapolated across lower elevation areas. Use caution with drift lines that may have been caused by extreme, infrequent, or very brief flooding events.

Indicator B4: Algal mat or crust

Category: Primary

General Description: This indicator consists of a mat or dried crust of algae, perhaps mixed with other detritus, left on or near the soil surface after dewatering.

Cautions and User Notes: Algal deposits include those produced by green algae (Chlorophyta) and blue-green algae (cyanobacteria). They may be attached to low vegetation or other fixed objects, or may cover the soil surface (Figure 30). Dried crusts of blue-green algae may crack and curl at plate margins (Figure 31). Algal deposits are usually seen in seasonally ponded areas, lake fringes, and low-gradient stream margins. They reflect prolonged wet conditions sufficient for algal growth and development. Algal mats or crusts are not common but can be found throughout Alaska.

Figure 30. Algal deposit on the soil surface in a *Juncus*-dominated marsh.

Figure 31. Dried crust of blue-green algae on the soil surface.

Indicator B5: Iron deposits

Category: Primary

General Description: This indicator consists of a thin orange or yellow crust or gel of oxidized iron on the soil surface or on objects near the surface.

Cautions and User Notes: Iron deposits form in areas where reduced iron discharges with groundwater and oxidizes upon exposure to air. The oxidized iron forms a film or sheen on standing water (Figure 32) and an orange or yellow deposit (Figures 33 and 34) on the ground surface after dewatering. Iron sheen on water can be distinguished from an oily film by touching with a stick or finger; iron films are crystalline and will crack into angular pieces.

Figure 32. Iron sheen on the water surface may be deposited as an orange or yellow crust after dewatering.

Figure 33. Iron deposit (orange area) in a ponded depression.

Figure 34. Iron deposit (reddish-orange color) on the soil surface in a dewatered wetland.

Indicator B6: Surface soil cracks

Category: Primary

General Description: Surface soil cracks consist of shallow cracks that form when fine-grained mineral or organic soil material dries and shrinks, often creating a network of cracks or small polygons (Figures 35 and 36).

Figure 35. Surface cracks in a mineral soil in a seasonally ponded wetland.

Figure 36. Surface cracks in an organic soil near Anchorage.

Cautions and User Notes: Surface soil cracks are usually seen in fine sediments in seasonally ponded depressions, lake fringes, and floodplains. Use caution, however, as they may also occur in temporary ponds and puddles in non-wetlands. This indicator should not be confused with patterned-ground features caused by frost action in Interior, Northern, and Western Alaska.

Indicator B7: Inundation visible on aerial imagery

Category: Primary

General Description: One or more recent aerial photographs or satellite images show the site to be inundated.

Cautions and User Notes: Recent aerial imagery should be used to evaluate this indicator. Older imagery may be useful if there has been no known hydrologic change (e.g., change in river course, tectonic activity, or human alteration) since the date of the photograph. If available, it is recommended that multiple years of photography be evaluated. Care must be used in applying this indicator because surface water may be present on a non-wetland site immediately after a heavy rain, during spring break-up, or during periods of unusually high precipitation, runoff, tides, or river stages. WETS tables provided by the NRCS National Water and Climate Center (http://www.wcc.nrcs.usda.gov/climate/wetlands.html) may be used to determine whether rainfall prior to the photo date was normal, greater than normal, or less than normal based on long-term records at National Weather Service stations. Even under normal rainfall conditions, some wetlands do not become inundated every year (i.e., wetlands are inundated or saturated at least 5 out of 10 years, or 50 percent or higher probability in a given year). Surface water observed during the non-growing season may be an acceptable indicator if experience and professional judgment suggest that wet conditions normally extend into the growing season for sufficient duration in most years. Surface water may be absent from a wetland during the normal dry season or during periods of drought. Normal seasonal and annual variations in water levels should be considered in interpreting this indicator.

Indicator B8: Sparsely vegetated concave surface

Category: Primary

General Description: On concave land surfaces (e.g., depressions and swales), the ground surface is either unvegetated or sparsely vegetated (less than 5 percent ground cover) due to long-duration ponding during the growing season (Figure 37).

Figure 37. A sparsely vegetated, seasonally ponded depression.

Cautions and User Notes: Ponding during the growing season can limit the establishment and growth of ground-layer vegetation. Sparsely vegetated concave surfaces should contrast with vegetated slopes and convex surfaces in the same area. A woody overstory of trees or shrubs may or may not be present. Use caution to avoid confusing this indicator with small bare areas resulting from patterned-ground processes in Northern, Interior, and Western Alaska.

Indicator B15: Marl deposits

Category: Primary

General Description: This indicator consists of the presence of marl on the soil surface.

Cautions and User Notes: Marl deposits consist mainly of calcium carbonate precipitated from standing water through the action of algae or diatoms. Marl appears as a tan or whitish deposit on the soil surface after dewatering (Figure 38) and may form thick deposits in some areas. Subsurface marl layers do not qualify for this indicator. Marl deposits are found mainly in Northern Alaska.

Figure 38. Marl deposit (tan-colored areas) and iron sheen in a subarctic fen.

Indicator B9: Water-stained leaves

Category: Secondary

General Description: Water-stained leaves are fallen leaves or needles that have turned grayish or blackish in color due to inundation for long periods.

Cautions and User Notes: Water-stained leaves are generally found in depressions, flats, or along stream margins in forested or shrub-dominated wetlands (Figure 39). Water-stained leaves maintain their blackish or grayish colors when dry. They should contrast strongly with fallen leaves in nearby non-wetland landscape positions.

Figure 39. Water-stained leaves.

Indicator B10: Drainage patterns

Category: Secondary

General Description: This indicator consists of flow patterns visible on the soil surface or eroded into the soil, low vegetation bent over in the direction of flow, absence of leaf litter or small woody debris due to flowing water, scouring of soil from around plant roots, and similar evidence that water flowed across the ground surface.

Cautions and User Notes: Drainage patterns are usually seen in areas where water flows broadly over the surface and is not confined to a channel, such as in areas adjacent to streams, slope wetlands, vegetated swales, and tidal flats (Figures 40 and 41). Use caution in areas affected by extreme or abnormal flooding events or by brief, temporary flooding during the spring break-up period.

Figure 40. Drainage patterns in a slope wetland.

Figure 41. Vegetation bent over in the direction of water flow across a stream terrace.

Group C – Evidence of Current or Recent Soil Saturation

Indicator C1: Hydrogen sulfide odor

Category: Primary

General Description: A hydrogen sulfide (rotten egg) odor within 12 in. (30 cm) of the soil surface.

Cautions and User Notes: Hydrogen sulfide is a gas produced by soil microbes in response to prolonged soil saturation. For hydrogen sulfide to be detectable, the soil must be saturated at the time of sampling and must have been saturated long enough to become highly reduced. These soils are often permanently saturated and anoxic at or near the surface. To apply this indicator, dig a pit no deeper than 12 in. to avoid release of hydrogen sulfide from deeper in the profile. Hydrogen sulfide odor serves as both an indicator of hydric soil and wetland hydrology. This one observation proves that the soil meets the definition of a hydric soil (i.e., anaerobic in the upper part), plus has an ongoing wetland hydrologic regime. Often these soils have a high water table (wetland hydrology indicator A2), but the hydrogen sulfide odor provides further proof that the soil has been saturated for an extended period of time.

Indicator C2: Dry-season water table

Category: Primary

General Description: Visual observation of the water table between 12 and 24 in. (30–60 cm) below the surface for mineral soils, or between 12 and 40 in. (30–100 cm) for organic soils, during the normal dry season or during a drier-than-normal year.

Cautions and User Notes: Due to normal seasonal fluctuations, water tables in wetlands often drop below 12 in. during the dry season. For sites with mineral soils in Alaska, an observed water table within 24 in. during the dry season, or during an unusually dry year, is strong evidence for a water table within 12 in. during the normal wet portion of the growing season. For organic soils, a dry-season water table within 40 in. indicates a normal wet-season water table within 12 in. A soil auger may be needed to evaluate this indicator. Sufficient time must be allowed for water to infiltrate into a newly dug hole and to stabilize at the water-table level. The required time will vary depending upon soil texture. In some cases, the water table can be determined by examining the wall of the soil pit and identifying the upper level at which water is seeping into the pit. For an accurate determination of the water-table level, the soil pit, auger hole, or well should not penetrate any restrictive soil layer capable of perching water near the surface. See Chapter 5 (section on Wetlands that Periodically Lack Indicators of Wetland Hydrology) to determine dry-season dates and for procedures to evaluate normal rainfall and snowpack.

Indicator C3: Oxidized rhizospheres along living roots

Category: Secondary

General Description: Presence of a layer containing 2 percent or more iron-oxide coatings or plaques on the surfaces of living roots and/or iron-oxide coatings or linings on soil pores immediately surrounding living roots within 12 in. (30 cm) of the soil surface (Figure 42).

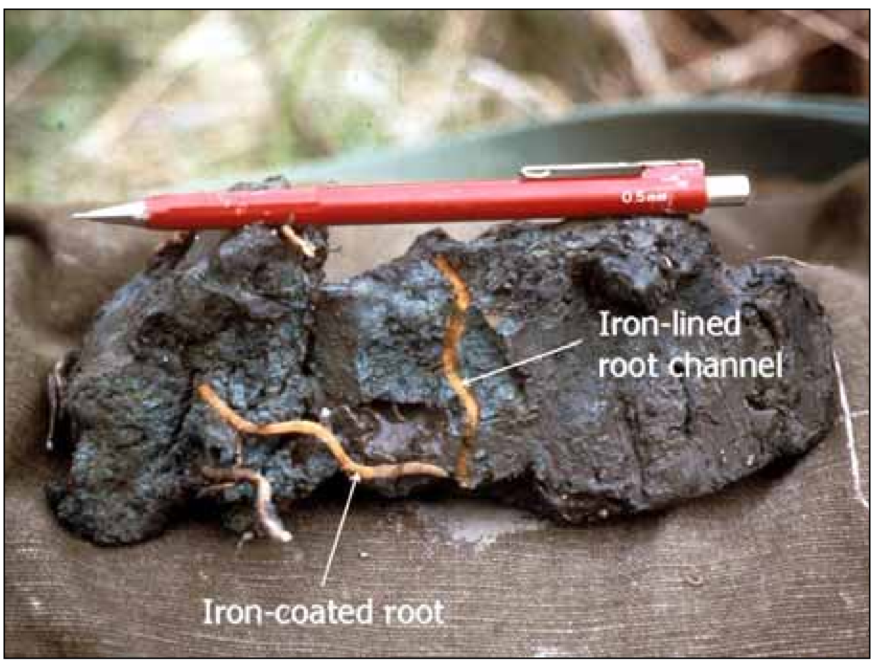

Figure 42. Iron-oxide plaque (orange coating) on a living root. Iron oxide also coats the channel or pore from which the root was removed.

Cautions and User Notes: Oxidized rhizospheres are the result of oxygen leakage from living roots into the surrounding anoxic soil, causing oxidation of ferrous iron present in the soil solution. They are evidence of saturated and reduced soil conditions during the plant's lifetime. Iron concentrations or plaques may form on the immediate root surface or may coat the soil pore adjacent to the root. In either case, the oxidized iron must be associated with living roots to indicate contemporary wet conditions and to distinguish these features from other pore linings. Care must be taken to distinguish iron-oxide coatings from organic matter associated with plant roots. Viewing with a hand lens may help distinguish mineral from organic material. Iron coatings sometimes show concentric layers in cross section and may transfer iron stains to the fingers when rubbed. Note the location and abundance of oxidized rhizospheres in the soil profile description or remarks section of the data form. There is no minimum thickness requirement for the layer containing oxidized rhizospheres. Oxidized rhizospheres must occupy at least 2 percent of the volume of the layer.

This indicator is assigned a Secondary rating in Alaska because of the potential for relict oxidized rhizospheres, still associated with living roots, in areas where the permafrost layer has thawed due to recent climate change or fires that have destroyed the insulating moss layer. Thawing of the permafrost can cause a drop in the water table and the loss of wetland hydrology. However, oxidized rhizospheres may persist until the death of the plants that produced them.

Indicator C4: Presence of reduced iron

Category: Secondary

General Description: Presence of a layer containing reduced (ferrous) iron in the upper 12 in. (30 cm) of the soil profile, as indicated by a positive reaction to a ferrous iron test or by the presence of a soil that changes color upon exposure to the air.

Cautions and User Notes: The reduction of iron occurs as a result of microbial activity in soils that have been saturated long enough to become anoxic and chemically reduced. Ferrous iron is converted back to oxidized forms when saturation ends and the soil reverts to an aerobic state. Therefore, the presence of ferrous iron usually indicates that the soil is saturated at the time of sampling and has been saturated for an extended period of time. The presence of ferrous iron can be verified with alpha, alpha-dipyridyl dye (Figure 43) or by observing a soil that changes color upon exposure to air (i.e., reduced matrix) (Figure 44). A positive reaction to alpha, alpha-dipyridyl dye should occur over more than 50 percent of the soil layer in question. The dye does not react when wetlands are dry;

Figure 43. When alpha, alpha-dipyridyl dye is applied to a soil containing reduced (ferrous) iron, a positive reaction is indicated by a pink or red coloration to the treated area.

Figure 44. In a reduced matrix, the rapid oxidation of ferrous iron in a freshly exposed soil sample (left side) results in a color change after exposure to the air for several minutes (right side).

therefore, a negative test result is not evidence that the soil is not reduced at other times of year. Soil samples should be tested or examined immediately after opening the soil pit because ferrous iron may oxidize and colors change soon after the sample is exposed to the air. To evaluate a color change, first determine soil color on a freshly broken sample from the newly opened pit, then repeat the color measurement on the same sample after a few minutes. Soils that contain little weatherable iron may not react even when saturated and reduced. There are no minimum thickness requirements or initial color requirements for the soil layer in question.

Indicator C5: Salt deposits

Category: Secondary

General Description: Salt deposits are whitish or brownish deposits of salts that accumulate on the ground surface through the capillary action of groundwater.

Cautions and User Notes: Salt deposits occur in areas of seasonal moisture deficit where evaporation brings capillary water to the surface (Figure 45). They often occur on floodplain terraces after surface water has receded and the water table is near the surface, such as along the Tanana and Susitna Rivers. Salt deposits are not known to occur in Southeast Alaska. Use caution in disturbed areas where salt water or brine has been deposited on the surface through runoff from surface sources, such as gravel piles.

Figure 45. Salt deposits on the soil surface.

Group D – Evidence from Other Site Conditions or Data

Indicator D1: Stunted or stressed plants

Category: Secondary

General Description: This indicator is present if individuals of the same species growing in the potential wetland are clearly of smaller stature, less vigorous, or stressed compared with individuals growing in nearby non-wetland situations (Figure 46).

Cautions and User Notes: Some plant species in Alaska grow in both wetlands and non-wetlands but may exhibit obvious stunting or stress in wet situations (e.g., *Picea mariana*). Use caution in areas where stunting of plants on non-wetland sites may be caused by low soil fertility, excessively drained soils, cold temperatures, shallow permafrost, or other factors. For this indicator to be present, a majority of individuals in the stand must be stunted or stressed. The comparison with individuals in non-wetland situations may be accomplished over a broad geographic area and is not limited to the project site.

Figure 46. Black spruce in the wetland (foreground) are stressed and stunted compared with spruce in the adjacent non-wetland (background).

Indicator D2: Geomorphic position

Category: Secondary

General Description: This indicator is present if the area in question is located in a localized depression or other concave surface, within a minor drainage or on an active floodplain, at the toe of a slope, on the low-elevation fringe of a pond or other water body, or in an area where ground-water discharges (Figures 47 and 48).

Cautions and User Notes: Excess water from precipitation and snowmelt naturally accumulates in certain geomorphic positions in the landscape, particularly in low-lying areas such as depressions, drainages, toe slopes, and fringes of water bodies. With the exceptions noted below, these areas in Alaska often exhibit wetland hydrology.

Exceptions: This indicator does not include depressional areas in karst topography in Southeast Alaska, which often drain freely. Furthermore, there are areas throughout Alaska where concave topography exists on rapidly permeable soils (e.g., outwash plains with sand and gravel substrates) that do not have wetland hydrology unless the water table is near the surface.

Figure 47. Certain geomorphic positions, such as this estuarine fringe in Southeast Alaska, are evidence of wetland hydrology.

Figure 48. Depressions and toe slopes are common wetland landscape positions in Alaska.

Indicator D3: Shallow aquitard

Category: Secondary

General Description: This indicator consists of the presence of an aquitard within 24 in. (60 cm) of the soil surface that is potentially capable of perching water within 12 in. (30 cm) of the surface.

Cautions and User Notes: An aquitard is a relatively impermeable soil layer or bedrock that slows the downward infiltration of water and can produce a perched water table. Potential aquitards include permafrost (Figure 49), dense glacial till, lacustrine deposits, iron-cemented layers, and clay layers. In some cases, the aquitard may be at the surface and cause water to pond on the surface. Soil layers that are only seasonally frozen do not qualify as aquitards unless they are observed to perch water for long periods during the growing season in most years.

Figure 49. Water perched over permafrost at 16 in. (40 cm) and seasonal frost at 9 in. (22 cm) saturates this soil above 9 in. (22 cm). Note the reduced soil colors. Picture taken at the Toolik Lake Field Research Station, North Slope, on 18 July 2006. Scale in centimeters.

Indicator D4: Microtopographic relief

Category: Secondary

General Description: This indicator consists of the presence of microtopographic features that are found in areas of seasonal inundation or shallow water tables, such as hummocks, flarks and strangs, tussocks, frost circles, or pedestals, with microhighs less than 36 in. (90 cm) above the base soil level.

Cautions and User Notes: These features are the result of vegetative and geomorphic processes in wetlands and produce characteristic micro-topographic diversity in some wetland systems (Figures 50 and 51). Microtopographic lows are either inundated or have shallow water tables for long periods each year. Microtopographic highs may or may not have wetland hydrology, but usually are small, narrow, or fragmented, often occupying less than half of the surface area. If indicators of hydrophytic vegetation or hydric soil are absent from microhighs, see the procedure for wetland/non-wetland mosaics in Chapter 5. This indicator does not include uneven topography due to vegetation-covered rocks, logs, or other debris, or features caused by trampling, such as caribou trails.

Figure 50. Microtopographic relief due to a shallow water table in a forested wetland near Sitka.

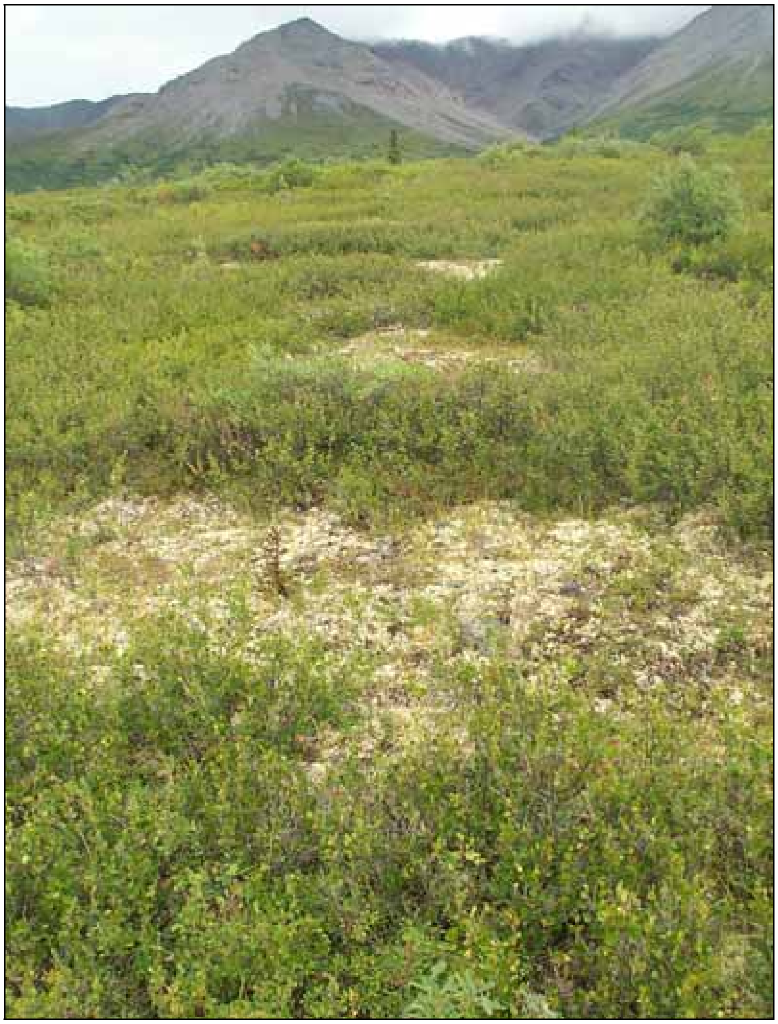

Figure 51. Frost circles in Denali National Park. Light-colored areas are microhighs dominated by lichens. Microlows are dominated by dwarf birch (*Betula nana*) and sedges.

Indicator D5: FAC-neutral test

Category: Secondary

General Description: The plant community passes the FAC-neutral test.

Cautions and User Notes: The FAC-neutral test is performed by compiling a list of dominant plant species across all strata in the community, and dropping from the list any species with a Facultative (FAC) indicator status. The FAC-neutral test is met if more than 50 percent of the remaining dominant species are rated FACW and/or OBL (see Figure 52 for an example calculation of the FAC-neutral test).

Step 1: Use the 50/20 rule to select dominant species from each stratum of the community.

Step 2: Combine dominant species from all strata into a single list. Determine the wetland indicator status for each dominant species (Reed 1988 or current list). For example:

Dominant Species	Stratum	Indicator Status
Picea mariana	Tree	FACW
Vaccinium vitis-idaea	Sapling/Shrub	FAC
Ledum groenlandicum	Sapling/Shrub	FACW
Carex bigelowii	Herb	FAC
Pyrola rotundifolia	Herb	FACU

Step 3: Drop the FAC species and sort the remaining species into two groups: FACW and OBL species, and FACU and UPL species:

FACW and OBL Species	FACU and UPL Species
Picea mariana	*Pyrola rotundifolia*
Ledum groenlandicum	

Step 4: Count the number of species in each group. If the number of dominant species that are FACW and OBL is greater than the number of dominant species that are FACU and UPL, the site passes the FAC-neutral test. In the example, two species (*Picea mariana* and *Ledum groenlandicum*) are FACW and/or OBL, and only one species (*Pyrola rotundifolia*) is FACU or UPL. Therefore, the site passes the FAC-neutral test.

Figure 52. Procedure and example of the FAC-neutral test.

This indicator can be used in communities that contain no FAC dominants. If there are an equal number of dominants that are OBL and FACW versus FACU and UPL, nondominant species should be considered. Dominant species in each stratum are identified by using the 50/20 rule (see Chapter 2, Hydrophytic Vegetation Indicator 1 – Dominance Test).

5 Difficult Wetland Situations in Alaska

Introduction

Some wetlands can be difficult to identify because wetland indicators may be missing at times due to natural processes or recent disturbances. This chapter provides guidance for making wetland determinations in difficult-to-identify wetland situations in Alaska. It includes regional examples of problem area wetlands and atypical situations as defined in the Corps Manual, as well as other situations that can make wetland delineation more challenging. Problem area wetlands are defined as naturally occurring wetland types that periodically lack indicators of hydrophytic vegetation, hydric soil, or wetland hydrology due to normal seasonal or annual variability. In addition, some problem area wetlands may permanently lack certain indicators due to the nature of the soils or plant species on the site. Atypical situations are defined as wetlands in which vegetation, soil, or hydrology indicators are absent due to recent human activities or natural events. In addition, this chapter addresses certain procedural problems (e.g., wetland/non-wetland mosaics) that can make wetland determinations in Alaska difficult or confusing. The chapter is organized into the following sections:

- Wetlands that Lack Indicators of Hydrophytic Vegetation
- Problematic Hydric Soils
- Wetlands that Periodically Lack Indicators of Wetland Hydrology
- Wetland/Non-Wetland Mosaics

The list of difficult wetland situations presented in this chapter is not intended to be exhaustive and other problematic situations may exist in the State. See the Corps Manual for general guidance. Furthermore, more than one wetland factor (i.e., vegetation, soil, and/or hydrology) may be disturbed or problematic on a given site. In general, *wetland determinations on difficult or problematic sites must be based on the best information available to the field inspector, interpreted in light of his or her professional experience and knowledge of the ecology of wetlands in the region.*

Wetlands that lack indicators of hydrophytic vegetation

Description of the problem

Some wetlands in Alaska are difficult to identify because their plant communities contain a prevalence of FACU species, causing them to fail the dominance test and prevalence index. In addition, some wetlands contain species that were assigned no indicator (NI), were not known to occur in Alaska (NO), or were not listed on the Alaska plant list. Unlisted species generally are assumed to be UPL; however, some species are unlisted due to recent taxonomic changes or lack of information about their affinities for wetlands. Some wetland communities that contain FACU, NI, NO, or unlisted species may exhibit other indicators of hydrophytic vegetation (e.g., morphological adaptations), but others may not. Examples of FACU species that may dominate in certain wetland situations include paper birch, white spruce, Sitka spruce, devil's club (*Oplopanax horridus*), and field horsetail. Sometimes these FACU species occur on hummocks, slightly elevated above the general soil level, where they can avoid the physiological effects of prolonged saturation in the root zone. Other FACU and UPL herbs and shrubs may co-occur with these species on hummocks. At other times, they may be more generally distributed across the wet area. Wetlands along creeks in the Anchorage basin, for example, are often dominated by paper birch growing on hummocks with field horsetail growing more widely in the understory. The following procedure can be used to identify hydrophytic vegetation in wetlands that lack hydrophytic vegetation indicators.

Disturbance by fire or other factors is another reason that indicators of hydrophytic vegetation may be absent in certain wetland situations in Alaska. In some cases, fire or other disturbances may remove or significantly alter the vascular plant community but leave the non-vascular community (i.e., mosses, liverworts, etc.) relatively unaffected, particularly in wet landscape positions. In the Anchorage and Fairbanks areas of Southcentral and Interior Alaska, Lichvar et al. (2007) identified several species of wetland-specialist bryophytes that can help identify hydrophytic vegetation on sites where the vascular flora is missing or altered. The method described in item 3d of the following procedure is restricted to areas normally dominated by black spruce in Southcentral and Interior Alaska, and should not be used to overrule other evidence of a hydrophytic plant community. The method may also be applicable in other parts of the State but has not been tested there.

Procedure

The following procedure can be used to determine whether hydrophytic vegetation is present in areas dominated by FACU, NI, NO, or unlisted plant species, or in areas where the vascular plant community has been disturbed by fire or other factors. This procedure should be applied only where indicators of hydric soil and wetland hydrology are present, unless one or both of these factors is also disturbed or problematic, but no indicators of hydrophytic vegetation are evident. The following procedure is recommended:

1. Verify that at least one indicator of hydric soil and one primary or two secondary indicators of wetland hydrology are present. If indicators of either hydric soil or wetland hydrology are absent, the area is likely non-wetland unless soil and/or hydrology are also disturbed or problematic. If indicators of hydric soil and wetland hydrology are present (or are absent due to disturbance or other problem situations), proceed to step 2.
2. Verify that the area is in a landscape position that is likely to collect or concentrate water. Appropriate settings include the following. If the landscape setting is appropriate, proceed to step 3.
    a. Concave surface (e.g., depression or swale)
    b. Active floodplain or low terrace
    c. Level or nearly level area (e.g., 0- to 3-percent slope)
    d. Toe slope or an area of convergent slopes
    e. Fringe of another wetland or water body
    f. Area with a restrictive soil layer or aquitard within 24 in. (60 cm) of the surface
    g. Area where groundwater discharges (e.g., a seep)
    h. Other (explain in field notes why this area is likely to be inundated or saturated for long periods)
3. Use one or more of the following approaches to determine whether the site has hydrophytic vegetation. In the remarks section of the data form or in the delineation report, explain the rationale for concluding that the plant community is hydrophytic even though indicators of hydrophytic vegetation described in Chapter 2 were not observed.
    a. *Direct hydrologic observations.* Verify that the plant community occurs in an area subject to prolonged inundation or soil saturation (evidenced by a shallow water table) during the growing season. This can be done by visiting the site at 2- to 3-day intervals during the portion of the growing season when surface water is most likely to be present or water tables are normally high. Hydrophytic vegetation is

considered to be present, and the site is a wetland, if surface water is present and/or a water table 12 in. (30 cm) or less from the surface is present for 14 or more consecutive days during the growing season during a period when antecedent precipitation has been normal or drier than normal. If necessary, microtopographic highs and lows should be evaluated separately. The normality of the previous winter's snowpack and current year's rainfall should be considered in interpreting field results, as well as the likelihood that wet conditions will occur on the site at least every other year (for more information, see the section on Wetlands that Periodically Lack Indicators of Wetland Hydrology in this chapter).

b. *Reference sites.* If indicators of hydric soil and wetland hydrology are present or problematic on a site with vegetation dominated by FACU, NI, NO, or unlisted species, the site may be considered to be a wetland if the landscape setting, topography, soils, and vegetation are substantially the same as those on nearby wetland reference areas. Hydrologic characteristics of wetland reference areas should be documented through long-term monitoring or by repeated application of the procedure described in item 3a above. Reference sites should be minimally disturbed and provide long-term access. Soils, vegetation, and hydrologic conditions should be thoroughly documented and the data kept on file in the District or field office.

c. *Supporting Documentation.* Published and unpublished scientific literature may be used to support a decision to treat specific FACU, NI, NO, or unlisted species as hydrophytes or certain plant communities as hydrophytic. Preferably, this documentation should discuss the species' natural distribution along the moisture gradient, its capabilities and adaptations for life in wetlands, wetland types in which it is typically found, or other wetland species with which it is commonly associated.

d. *Wetland Non-Vascular Plants.* In Southcentral and Interior Alaska, in areas that normally support black spruce but the vascular flora has been altered or removed by fire or other disturbance, the presence and abundance of certain wetland-specialist bryophytes can be used to determine whether the vegetation is hydrophytic. Hydrophytic vegetation is present if more than 50 percent of the total coverage of bryophytes consists of species known to be highly associated with wetlands (Table 7). Additional information and sampling guidance is given in Appendix C. Use the following procedure:

Table 7. Bryophytes that are highly associated with wetlands in Interior and Southcentral Alaska

Aulacomnium palustre	*Polytrichum strictum*
Blepharostoma trichophyllum (hepatic)	*Sphagnum angustifolium*
Calliergon stramineum	*Sphagnum fuscum*
Calypogeia sphagnicola (hepatic)	*Sphagnum papillosum*
Drepanocladus spp.	*Sphagnum russowii*
Meesia triquetra	*Sphagnum squarrosum*
Meesia uliginosa	*Sphagnum warnstorfii*
Mylia anomala (hepatic)	*Tomenthypnum nitens*
Pohlia proligera	

(1) Estimate the absolute percent cover of each species of bryophyte (i.e., mosses, liverworts, and hornworts) within one or more 10- by 10-in. (25- by 25-cm) square plots placed at the base of any hummocks, if present. Calculate the total bryophyte cover by summing the absolute cover values for all species in the plot; therefore, total coverage can exceed 100 percent. Not all species need to be identified, if they are not wetland specialists. Lichens and fungi should not be included.

(2) Identify the wetland-specialist bryophytes present (Table 7) and sum their cover values within plots.

(3) Divide the summed cover value of wetland-specialist bryophytes by the total bryophyte cover in the plot and multiply by 100 to convert to a percentage. Average these percentages across plots, if needed.

(4) If more than 50 percent of the total bryophyte cover consists of wetland specialists, then the vegetation is hydrophytic.

Problematic hydric soils

Description of the problem

Some soils that meet the hydric soil definition may not exhibit any of the indicators presented in Chapter 3. These problematic hydric soils exist for a number of reasons and require additional information, such as landscape position, presence or absence of restrictive soil layers, or information about hydrology, for proper identification. This section describes several soil situations in Alaska that are considered hydric if additional requirements are met. In some cases, the lack of hydric soil indicators is due to conditions that inhibit the development of redoximorphic features despite prolonged soil saturation and anoxia. In addition, recently developed wetlands may lack hydric soil indicators because insufficient time has passed for their development. Examples of problematic hydric soils in Alaska include, but are not limited to, the following:

1. **Soils with low organic-carbon content.** Soil microbes require the presence of sufficient organic carbon in a soil to thrive. If little or no organic carbon is present in a saturated soil, microbial activity will often be insufficient to produce noticeable hydric soil indicators. This is especially true in young or recently formed soils. Examples include recently formed sandy and gravelly soils (Figure 53).

Figure 53. Low organic-matter content and coarse gravelly materials can make identification of hydric soil indicators difficult.

2. **Soils with low weatherable-iron content.** A soil may contain little or no weatherable iron-bearing material due to the mineralogy of the parent material in which it formed. Gley colors, iron depletions, redox concentrations, and reaction to alpha, alpha-dipyridyl dye all require the presence of weatherable iron. If sufficient weatherable iron-bearing material is lacking in a saturated soil, these hydric soil indicators will be very weak or absent. Examples include soils formed in some types of volcanic ash or from diorite parent materials.
3. **Soils with pH of 7.2 or higher.** The formation of redox concentrations and depletions requires that soluble iron be present in the soil. Iron readily enters into solution in acidic soils. In soils with higher pH, less iron enters into solution. As a result, redox concentrations may be very faint and difficult to observe in a soil with higher pH. Examples include soils in the Copper River Basin that have high pH due to the influence of parent material (Figure 54).

Figure 54. Gley colors and redox concentrations are relatively faint due to the high pH of the soil materials in this profile from the Copper River Basin.

4. **Recently developed wetlands.** Recently developed wetlands include mitigation sites, wetland management areas (e.g., for waterfowl), other wetlands intentionally or unintentionally produced by human activities, and naturally occurring wetlands that have not been in place long enough to develop hydric soil indicators. These soils should be considered hydric if they are ponded, flooded, or saturated for 14 or more consecutive days during the growing season in most years based on actual data and not on estimated soil properties.

Procedure

Soils that meet the definition of a hydric soil but do not exhibit any of the indicators described in Chapter 3 can be identified by the following recommended procedure. This procedure should be used only where indicators of hydrophytic vegetation and wetland hydrology are present, unless one or both factors are also disturbed or problematic, but indicators of hydric soil are not evident.

1. Verify that one or more indicators of hydrophytic vegetation are present or that the vegetation is disturbed or problematic. If so, proceed to step 2.
2. Verify that at least one primary indicator of wetland hydrology is present, or that hydrology indicators are absent due to disturbance or other problems. In this procedure, secondary indicators are not considered to be sufficient evidence of wetland hydrology. If at least one primary indicator of wetland hydrology is present (or indicators are absent due to disturbance or other problem situations), proceed to step 3.
3. Thoroughly describe and document the soil profile and landscape setting. Verify that the area is in a landscape position that is likely to collect or concentrate water. Appropriate settings include the following. If the landscape setting is appropriate, proceed to step 4.
   a. Concave surface (e.g., depression or swale)
   b. Active floodplain or low terrace
   c. Level or nearly level area (e.g., 0- to 3-percent slope)
   d. Toe slope or an area of convergent slopes
   e. Fringe of another wetland or water body
   f. Area with a restrictive soil layer or aquitard within 24 in. (60 cm) of the surface
   g. Area where groundwater discharges (e.g., a seep)
   h. Other (explain in field notes why this area is likely to be inundated or saturated for long periods)

4. Use one or more of the following approaches to determine whether the soil is hydric. In the remarks section of the data form or in the delineation report, explain why it is believed that the soil lacks any of the NTCHS hydric soil indicators described in Chapter 3 and why it is believed that the soil meets the definition of a hydric soil.
   a. Determine whether one or more of the following indicators of problematic hydric soils is present (see Chapter 3 for descriptions of these indicators). If one or more indicators is present, then the soil is hydric.
      (1) Alaska Color Change (TA4)
      (2) Alaska Alpine Swales (TA5)
      (3) Alaska Redox with 2.5Y Hue
      (4) Alaska Gleyed without Hue 5Y or Redder Underlying Layer
   b. Determine whether one or more of the following problematic hydric soil situations is present. If so, then the soil is hydric.
      (1) Soil has low organic-matter content (e.g., recently deposited sandy or gravelly soils)
      (2) Soil has low weatherable-iron content
      (3) Soil has high pH (7.2 or higher)
      (4) Area is a recently developed wetland
   c. If the soil is saturated at the time of sampling, alpha, alpha-dipyridyl dye can be used in the following procedure to determine if reduced (ferrous) iron is present. If ferrous iron is present as described below, then the soil is hydric.

      Alpha, alpha-dipyridyl is a dye that reacts with reduced iron. In some cases, it can be used to provide evidence that a soil is hydric when it lacks other hydric soil indicators. The soil is likely to be hydric if application of alpha, alpha-dipyridyl dye to mineral soil material in at least 60 percent of a layer at least 4 in. (10 cm) thick within a depth of 12 in. (30 cm) from the soil surface results in a positive reaction within 30 seconds evidenced by a pink or red coloration to the dye during the growing season.

      Using a dropper, apply a small amount of dye to a freshly broken ped face to avoid any chance of a false positive test due to iron contamination from digging tools. Look closely at the treated soil for evidence of color change. If in doubt, apply the dye to a sample of known upland soil and compare the reaction to the sample of interest. A positive reaction will not be present in soils that lack iron. The lack of a positive reaction to the dye does not preclude the presence of a hydric soil. Specific information about the use of alpha, alpha-dipyridyl can be found in NRCS Hydric Soils Technical Note 8 (http://soils.usda.gov/use/hydric/ntchs/tech_notes/note8.html).

d. Using gauge data, water-table monitoring data, or repeated direct hydrologic observations, determine whether the soil is ponded or flooded, or the water table is 12 in. (30 cm) or less from the surface, for 14 or more consecutive days during the growing season in most years (50 percent or higher probability) (U. S. Army Corps of Engineers 2005). If so, then the soil is hydric. Furthermore, any soil that meets the NTCHS hydric soil technical standard (NRCS Hydric Soils Technical Note 11, http://soils.usda.gov/use/hydric/ntchs/tech_notes/index.html) is hydric.

Wetlands that periodically lack indicators of wetland hydrology

Description of the problem

Wetlands are areas that are flooded or ponded, or have soils that are saturated with water, for long periods during the growing season in most years. Saturation in the root zone leads to anaerobic conditions and the unique vegetation and soil characteristics that are used to identify wetlands in the field. If the site is visited during a time of normal precipitation amounts and it is inundated or the water table is near the surface, then the wetland hydrology determination is straightforward. However, many wetlands dry out for part of the year, particularly around their margins where they grade into the surrounding non-wetlands. Furthermore, some wetlands may inundate or saturate only briefly, or not at all, in some years, although they exhibit obvious wetland hydrology during most years in a long-term record.

Wetland hydrology determinations are based on indicators, many of which were designed to be used during drier periods when the direct observation of surface water or a shallow water table is not possible. However, some wetlands may lack any of the listed hydrology indicators, particularly during the normal dry season or in a drier-than-normal year. The evaluation of wetland hydrology requires special care on any site where indicators of hydrophytic vegetation and hydric soil are present but hydrology indicators appear to be absent. This evaluation should consider the timing of the site visit in relation to normal seasonal and annual hydrologic variability, and whether antecedent snowpack and rainfall conditions have been normal. This section describes a number of approaches that can be used to determine whether wetland hydrology is present on sites where indicators of hydrophytic vegetation and hydric soil are present but hydrology indicators may be lacking due to normal variations in rainfall or runoff, human activities that destroy hydrology indicators, and other factors.

Procedure

The following recommended procedure may be used whenever wetland hydrology indicators appear to be absent on a site containing hydrophytic vegetation and hydric soil. Note that some of these approaches require meteorological data that may not be available for some sites due to the distance between weather stations in Alaska, the relatively low elevation of most stations, and the effects of topography on local weather patterns.

1. Verify that indicators of hydrophytic vegetation and hydric soil are present, or are absent due to disturbance or other problem situations. If these conditions are present, proceed to step 2.
2. Verify that the area is in a landscape position that is likely to collect or concentrate water. Appropriate settings include the following. If the landscape setting is appropriate, proceed to step 3.
   a. Concave surface (e.g., depression or swale)
   b. Active floodplain or low terrace
   c. Level or nearly level area (e.g., 0- to 3-percent slope)
   d. Toe slope or an area of convergent slopes
   e. Fringe of another wetland or water body
   f. Area with a restrictive soil layer or aquitard within 24 in. (60 cm) of the surface
   g. Area where groundwater discharges (e.g., a seep)
   h. Other (explain in field notes why this area is likely to be inundated or saturated for long periods)
3. Use one or more of the following approaches to determine whether wetland hydrology is present and the site is a wetland. In the remarks section of the data form or in the delineation report, explain the rationale for concluding that wetland hydrology is present even though indicators of wetland hydrology described in Chapter 4 were not observed.
   a. *Site visits during the dry season*. Determine whether the site visit occurred during the normal annual "dry season." The dry season, as used in this supplement, is the period of the year when water tables normally fall to low levels in response to decreased precipitation and/or increased evapotranspiration, usually during the summer. It

also includes the beginning of the recovery period in late summer. The following are approximate average dates of the dry season for various areas within the State (within areas, actual dates vary by locale and year):

Aleutian Alaska – no significant dry season
Southeast Alaska – no significant dry season
Southcentral Alaska (Anchorage basin) – mid-May through late July
Interior Alaska – mid-May through late July
Western Alaska – mid-May through late July
Northern Alaska – no significant dry season due to the extended period of thaw

Another source of information that can be used to determine dry seasons is the Web-Based Water-Budget Interactive Modeling Program (WebWIMP) (http://climate.geog.udel.edu/~wimp/). WebWIMP will calculate the approximate dates of wet and dry seasons for any terrestrial location based on average monthly precipitation and estimated evapotranspiration. In general, the dry season in a typical year is indicated when potential evapotranspiration exceeds precipitation (indicated by negative values of DIFF in the WebWIMP output), resulting in drawdown of soil moisture storage (negative values of DST) and/or a moisture deficit (positive values of DEF, also called the unmet atmospheric demand for moisture). Actual dates for the dry season vary by locale and year.

In many wetlands, direct observation of flooding, ponding, or a shallow water table would be unexpected during the dry season. Wetland hydrology indicators, if present, would most likely be limited to indirect evidence, such as water marks, drift deposits, or surface cracks. In some situations, hydrology indicators may be absent during the growing season. If the site visit occurred during the dry season on a site that contains hydric soils and hydrophytic vegetation and no evidence of hydrologic manipulation (e.g., no drainage ditches, dams, levees, water diversions, etc.), consider the site to be a wetland. If necessary, re-visit the site during the normal wet season and check again for the presence or absence of wetland hydrology indicators. If wetland hydrology indicators are absent during the wet portion of the growing season in a normal or wetter-than-normal rainfall year, the site is probably non-wetland.

b. *Years with unusually low winter snowpack*. Determine whether the site visit occurred following a winter with unusually low snowpack. In portions of Alaska where the snowpack persists throughout the winter, water availability in spring and early summer depends on winter water storage in the form of snow and ice. Therefore, springtime water availability in a given year can be evaluated by comparing the liquid equivalent of snowfall over the previous winter (e.g., September through April) against 30-year averages calculated for National Weather Service meteorological stations (http://lwf.ncdc.noaa.gov/oa/ncdc.html) or for NRCS SNOTEL sites (http://www.wcc.nrcs.usda.gov/factpub/ads/ads_ak.html). This procedure may not be reliable in areas where the snowpack is not persistent and water is released intermittently throughout the winter.

In years when winter snowpack is appreciably less than the long-term average, wetlands that depend on snowmelt as an important water source may not flood, pond, or develop shallow water tables and may not exhibit other wetland hydrology indicators. Under these conditions, a site that contains hydric soils and hydrophytic vegetation and no evidence of hydrologic manipulation (e.g., no drainage ditches, dams, levees, water diversions, etc.) should be considered to be a wetland. If necessary, re-visit the site following a winter with normal snowpack conditions and check again for hydrology indicators.

c. *Periods with below-normal rainfall*. Determine whether the amount of rainfall that occurred in the 2–3 months preceding the site visit was normal, above normal, or below normal based on the normal range reported in WETS tables. In areas where the snowpack does not persist over winter, or for sampling dates later in the growing season, WETS tables provided by the NRCS National Water and Climate Center (http://www.wcc.nrcs.usda.gov/climate/wetlands.html) can be used to determine whether rainfall in a given month was normal, above normal, or below normal based on long-term weather records. To determine whether precipitation was normal prior to the site visit, actual rainfall in the current month and previous 2–3 months should be compared with the normal ranges for each month given in the WETS table (USDA Natural Resources Conservation Service 1997, Sprecher and Warne 2000). The lower and upper limits of the normal range are indicated by the columns labeled “30% chance will have less than” and “30% chance will have more than.” In Alaska, however, weather stations are widely scattered and data may not be available in some areas.

When precipitation has been below normal, wetlands may not flood, pond, or develop shallow water tables during the typical wet portion of the growing season and may not exhibit other indicators of wetland hydrology. Under these conditions, a site that contains hydric soils and hydrophytic vegetation and no evidence of hydrologic manipulation (e.g., no drainage ditches, dams, levees, water diversions, etc.) should be considered to be a wetland. If necessary, re-visit the site during a period of normal rainfall and check again for hydrology indicators.

d. *Reference sites*. If indicators of hydric soil and hydrophytic vegetation are present on a site that lacks wetland hydrology indicators, the site may be considered to be a wetland if the landscape setting, topography, soils, and vegetation are substantially the same as those on nearby wetland reference areas. Wetland reference areas should have documented hydrology established through long-term monitoring (see item *e* below) or by repeated application of the procedure described in item 3a on page 85 (Direct Hydrologic Observations) of the procedure for Wetlands that Lack Indicators of Hydrophytic Vegetation in this chapter. Reference sites should be minimally disturbed and provide long-term access. Soils, vegetation, and hydrologic conditions should be thoroughly documented and the data kept on file in the District or field office.
e. *Long-term hydrologic monitoring*. On sites where the hydrology has been manipulated by man (e.g., with ditches, dams, levees, water diversions, land grading) or where natural events (e.g., change in river course, tectonic activity) have altered conditions such that hydrology indicators may be missing or misleading, direct monitoring of surface and groundwater may be needed to determine the presence or absence of wetland hydrology. The U. S. Army Corps of Engineers (2005) provides minimum standards for the design, construction, and installation of water-table monitoring wells, and for the collection and interpretation of groundwater monitoring data, in cases where direct hydrologic measurements are needed to determine whether wetlands are present on highly disturbed or problematic sites. This standard calls for 14 or more consecutive days of flooding, ponding, or a water table 12 in. (30 cm) or less below the surface during the growing season

at a minimum frequency of 5 years in 10 (50 percent or higher probability), unless a different standard has been established for a particular geographic area or wetland type. A disturbed or problematic site that meets this standard has wetland hydrology. This standard is not intended (1) to overrule an indicator-based wetland determination on a site that is not disturbed or problematic, or (2) to test or validate existing or proposed wetland indicators.

Wetland/non-wetland mosaics

Description of the problem

In this supplement, "mosaic" refers to a landscape where wetland and non-wetland components are too closely associated to be easily delineated or mapped separately. These areas often have complex microtopography, with repeated small changes in elevation occurring over short distances. The horizontal distance from trough to ridge may be 1 ft (30 cm) or less in some areas, such as those with plants growing in tussocks, to 10 ft (3 m) or more in broadly hummocky areas. Ridges and hummocks are often non-wetland but are interspersed throughout a wetland matrix having clearly hydrophytic vegetation, hydric soils, and wetland hydrology.

Examples of wetland/non-wetland mosaics include many strangmoor/patterned bog systems with flarks (depressions, flooded in spring) and strangs (linear, knee-high ridges, usually oriented at right angles to the original flow of water over the area), frost circles, patterned ground, and other types of periglacial microtopography. Wetland/non-wetland mosaics also occur in areas of discontinuous permafrost (e.g., north-facing slopes, and burned areas in permafrost-affected regions) and on discharge slopes in Southcentral Alaska. In the Anchorage area, wetlands adjacent to streams often contain hummocks associated with the root crowns of trees, and black spruce bogs may contain many knee-high hummocks, usually less than 40 in. (1 m) across the tops.

Wetland components of a mosaic are often not difficult to identify. The problem for the wetland delineator is that microtopographic features are too small and intermingled, and there are too many such features per acre, to delineate and map them accurately. Instead, the following sampling approach is designed to estimate the percentage of wetland in the mosaic. From this, the number of acres of wetland on the site can be calculated, if needed.

Procedure

First, identify and flag all contiguous areas of either wetland or non-wetland on the site that are large enough to be delineated and mapped separately. The remaining area should be mapped as "wetland/non-wetland mosaic" and the approximate percentage of wetland within the area determined by the following procedure.

1. Establish one or more continuous line transects across the mosaic area, as needed. Measure the total length of each transect. A convenient method is to stretch a measuring tape along the transect and leave it in place while sampling. If the site is shaped appropriately and multiple transects are used, they should be arranged in parallel with each transect starting from a random point along one edge of the site. However, other arrangements of transects may be needed for oddly shaped sites.
2. Use separate data forms for the swale or trough and for the ridges or hummocks. Sampling of vegetation, soil, and hydrology should follow the general procedures described in the Corps Manual and this supplement. Plot sizes and shapes for vegetation sampling must be adjusted to fit the microtopographic features on the site. Plots intended to sample the troughs should not overlap adjacent hummocks, and vice versa. Only one or two data forms are required for each microtopographic position, and do not need to be repeated for similar features or plant communities.
3. Identify every wetland boundary in every trough or swale encountered along each transect. Each boundary location may be marked with a pin flag or simply recorded as a distance along the stretched tape.
4. Determine the total distance along each transect that is occupied by wetland and non-wetland until the entire length of the line has been accounted for. Sum these distances across transects, if needed. Determine the percentage of wetland in the wetland/non-wetland mosaic by the following formula.

$$\%\ wetland = \frac{Total\ wetland\ distance\ along\ all\ transects}{Total\ length\ of\ all\ transects} \times 100$$

An alternative approach involves point-intercept sampling at fixed intervals along transects across the area designated as wetland/non-wetland mosaic. This method avoids the need to identify wetland boundaries in each swale, and can be carried out by pacing rather than stretching a measuring tape across the site. The investigator uses a compass or other means to follow the selected transect line. At a fixed number of paces (e.g., every two steps) the wetland status of that point is determined by observing indicators of hydrophytic vegetation, hydric soil, and wetland hydrology. Again, a completed data form is not required at every point but at least one representative swale and hummock should be documented with completed forms. After all transects have been sampled, the result is a number of wetland sampling points and a number of non-wetland points. Estimate the percentage of wetland in the wetland/non-wetland mosaic by the following formula:

$$\%\ wetland = \frac{Number\ of\ wetland\ points\ along\ all\ transects}{Total\ number\ of\ points\ sampled\ along\ all\ transects} \times 100$$

If high-quality aerial photography is available for the site, a third approach to estimating the percentage of wetland in a wetland/non-wetland mosaic is to use a dot grid, planimeter, or geographic information system (GIS) to determine the percentage of ridges (non-wetlands) and swales (wetlands) through photo interpretation of topography and vegetation patterns. This technique requires onsite verification that most ridges qualify as non-wetlands and most swales qualify as wetlands. In addition, with the agreement of the District, the landowner, and other stakeholders, the percentage of wetland in a wetland/non-wetland mosaic can be determined by concurrence on a visual estimate in the field.

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Appendix A: Glossary

This glossary is intended to supplement those given in the Corps Manual and other available sources. See the following publications for terms not listed here:

- Corps Manual (Environmental Laboratory 1987, or current version) (http://el.erdc.usace.army.mil/wetlands/pdfs/wlman87.pdf).
- Field Indicators of Hydric Soils in the United States (USDA Natural Resources Conservation Service 2006, or current version) (http://soils.usda.gov/use/hydric/).
- National Soil Survey Handbook, Part 629 (USDA Natural Resources Conservation Service 2005b) (ftp://ftp-fc.sc.egov.usda.gov/NSSC/Soil_Survey_Handbook/629_glossary.pdf).

Absolute cover. In vegetation sampling, the percentage of the ground surface that is covered by the aerial portions (leaves and stems) of a plant species when viewed from above. Due to overlapping plant canopies, the sum of absolute cover values for all species in a community or stratum may exceed 100 percent. In contrast, "relative cover" is the absolute cover of a species divided by the total coverage of all species in that stratum, expressed as a percent. Relative cover cannot be used to calculate the prevalence index.

Aquitard. A layer of soil or rock that retards the downward flow of water and is capable of perching water above it. For the purposes of this supplement, the term aquitard also includes the term aquiclude, which is a soil or rock layer that is incapable of transmitting significant quantities of water under ordinary hydraulic gradients.

Contrast. The color difference between a redox concentration and the dominant matrix color. Differences are classified as faint, distinct, or prominent and are defined in the glossary of USDA Natural Resources Conservation Service (2006) and illustrated in Table A1.

Table A1. Tabular key for contrast determinations using Munsell notation

Hues are the same (Δ h = 0)			Hues differ by 2 (Δ h = 2)		
Δ Value	Δ Chroma	Contrast	Δ Value	Δ Chroma	Contrast
0	≤1	Faint	0	0	Faint
0	2	Distinct	0	1	Distinct
0	3	Distinct	0	≥2	Prominent
0	≥4	Prominent	1	≤1	Distinct
1	≤1	Faint	1	≥2	Prominent
1	2	Distinct	≥2	---	Prominent
1	3	Distinct			
1	≥4	Prominent			
≤2	≤1	Faint			
≤2	2	Distinct			
≤2	3	Distinct			
≤2	≥4	Prominent			
3	≤1	Distinct			
3	2	Distinct			
3	3	Distinct			
3	≥4	Prominent			
≥4	---	Prominent			
Hues differ by 1 (Δ h = 1)			*Hues differ by 3 or more (Δ h ≥ 3)*		
Δ Value	Δ Chroma	Contrast	Δ Value	Δ Chroma	Contrast
0	≤1	Faint	Color contrast is prominent, except for low chroma and value.		Prominent
0	2	Distinct			
0	≥3	Prominent			
1	≤1	Faint			
1	2	Distinct			
1	≥3	Prominent			
2	≤1	Distinct			
2	2	Distinct			
2	≥3	Prominent			
≥3	---	Prominent			

Note: If both colors have values of ≤3 and chromas of ≤2, the color contrast is *Faint* (regardless of the difference in hue).
Adapted from USDA Natural Resources Conservation Service (2002)

Cryoturbation. The churning and mixing of soil horizons by frost processes (Williams and Smith 1989).

Depleted matrix. The volume of a soil horizon or subhorizon from which iron has been removed or transformed by processes of reduction and translocation to create colors of low chroma and high value. A, E, and calcic horizons may have low chromas and high values and may therefore be mistaken for a depleted matrix. However, they are excluded from the concept of depleted matrix unless common or many, distinct or prominent redox concentrations as soft masses or pore linings are present. In some places the depleted matrix may change color upon exposure to air (reduced matrix); this phenomenon is included in the concept of depleted matrix. The following combinations of value and chroma identify a depleted matrix:

- Matrix value of 5 or more and chroma of 1, with or without redox concentrations occurring as soft masses and/or pore linings, or
- Matrix value of 6 or more and chroma of 2 or 1, with or without redox concentrations occurring as soft masses and/or pore linings, or
- Matrix value of 4 or 5 and chroma of 2, with 2 percent or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings, or
- Matrix value of 4 and chroma of 1, with 2 percent or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings (USDA Natural Resources Conservation Service 2006).

Common (2 to less than 20 percent) to many (20 percent or more) redox concentrations (USDA Natural Resources Conservation Service 2002) are required in soils with matrix colors of 4/1, 4/2, and 5/2 (Figure A1). Redox concentrations include iron and manganese masses and pore linings (Vepraskas 1992). See “contrast” in this glossary for the definitions of “distinct” and “prominent.”

Figure A1. Illustration of values and chromas that require 2 percent or more distinct or prominent redox concentrations and those that do not, for hue 10YR, to meet the definition of a depleted matrix. *Due to inaccurate color reproduction, do not use this page to determine soil colors in the field.* Background image from the Munsell Soil Color Charts reprinted courtesy of Munsell Color Services Lab, a part of X-Rite, Inc.

Distinct. See Contrast.

Episaturation. Condition in which the soil is saturated with water at or near the surface, but also has one or more unsaturated layers below the saturated zone. The zone of saturation is perched on top of a relatively impermeable layer.

Folistels. Histels that are saturated with water for less than 30 cumulative days during normal years and are not artificially drained. See *Soil Taxonomy* (USDA Natural Resources Conservation Service 1999) for a complete definition.

Folistic epipedon. Generally defined as an organic layer that is saturated for less than 30 days cumulative and is 6 in. (15 cm) or more thick. See *Soil Taxonomy* (USDA Natural Resources Conservation Service 1999) for a complete definition.

Gleyed matrix. A gleyed matrix has one of the following combinations of hue, value, and chroma and the soil is not glauconitic (Figure A2):

- 10Y, 5GY, 10GY, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value of 4 or more and chroma of 1; or
- 5G with value of 4 or more and chroma of 1 or 2; or
- N with value of 4 or more (USDA Natural Resources Conservation Service 2006).

Figure A2. For hydric soil determinations, a gleyed matrix has the hues and chroma identified in this illustration with a value of 4 or more. *Due to inaccurate color reproduction, do not use this page to determine soil colors in the field.* Background image from the Munsell Soil Color Charts reprinted courtesy of Munsell Color Services Lab, a part of X-Rite, Inc.

Growing season. In Alaska, growing season dates are determined by evaluating vegetation green-up, maintenance, and senescence at the site location, based on direct observation or remote-sensing methods (see Growing Season in Chapter 4). Growing season determinations for wetland delineation purposes are subject to Corps of Engineers review and approval.

Histels. Organic soils that contain permafrost. See *Soil Taxonomy* (USDA Natural Resources Conservation Service 1999) for a complete definition.

Permafrost. A thickness of soil or other superficial deposits, or even bedrock, which has been colder than 0 °C for two or more years (Muller 1945).

Prominent. See Contrast.

Reduced matrix. Soil matrix that has a low chroma in situ due to the presence of reduced iron, but whose color changes in hue or chroma when exposed to air as Fe^{+2} is oxidized to Fe^{+3} (Vepraskas 1992).

Saturation. For wetland delineation purposes, a soil layer is saturated if virtually all pores between soil particles are filled with water (National Research Council 1995, Vepraskas and Sprecher 1997). This definition includes part of the capillary fringe above the water table (i.e., the tension-saturated zone) in which soil water content is approximately equal to that below the water table (Freeze and Cherry 1979).

Seasonal frost. Any material, including soil, which has a temperature of 0 °C or below for a period of less than one year.

Tree throw. The churning and mixing of soil horizons caused by the uplifted roots of wind-felled trees.

Appendix B: Point-Intercept Sampling Procedure for Determining Hydrophytic Vegetation

The following procedure for point-intercept sampling is an alternative to plot-based sampling methods to estimate the abundance of plant species in a community. Advantages of point-intercept sampling include better quantification of plant species abundance and reduced bias compared with visual estimates of cover. The method is useful in communities with high species diversity, and in areas where vegetation is patchy or heterogeneous, making it difficult to identify representative locations for plot sampling. Disadvantages include the increased time required for sampling and the need for vegetation units large enough to permit the establishment of one or more transect lines within them. Furthermore, plant species that are uncommon on the site may not be detected. The approach also assumes that soil and hydrologic conditions are uniform across the area where transects are located. In particular, transects should not cross the wetland boundary. Point-intercept sampling is generally used with a transect-based prevalence index (see below) to determine whether vegetation is hydrophytic.

In point-intercept sampling, plant occurrence is determined at points located at fixed intervals along one or more transects established in random locations within the plant community or vegetation unit. If a transect is being used to sample the vegetation near a wetland boundary, the transect should be placed parallel to the boundary and should not cross either the wetland boundary or into other communities. Usually a measuring tape is laid on the ground and used for the transect line. Transect length depends upon the size and complexity of the plant community and may range from 100 to 300 ft (30 to 90 m) or more. Plant occurrence data are collected at fixed intervals along the line, for example every 2 ft (0.6 m). At each interval, a "hit" on a species is recorded if a vertical line at that point would intercept the stem or foliage of that species. Only one "hit" is recorded for a species at a point even if the same species would be intercepted more than once at that point. Vertical intercepts can be determined using a long pin or rod protruding into and through the various vegetation layers, a sighting device (e.g., for the canopy), or an imaginary vertical line.

The total number of "hits" for each species along the transect is then determined. The result is a list of species and their frequencies of occurrence along the line (Mueller-Dombois and Ellenberg 1974, Tiner 1999). Species are then categorized by wetland indicator status (i.e., OBL, FACW, FAC, FACU, or UPL), the total number of hits determined within each category, and the data used to calculate a transect-based prevalence index. The formula is similar to that given in Chapter 2 for the plot-based prevalence index (see Indicator 2), except that frequencies are used in place of cover estimates. The community is hydrophytic if the prevalence index is 3.0 or less. To be valid, more than 80 percent of "hits" on the transect must be of species that have been identified correctly and placed in an indicator category.

The transect-based prevalence index is calculated using the following formula:

$$PI = \frac{F_{OBL} + 2F_{FACW} + 3F_{FAC} + 4F_{FACU} + 5F_{UPL}}{F_{OBL} + F_{FACW} + F_{FAC} + F_{FACU} + F_{UPL}}$$

where:

PI = prevalence index
F_{OBL} = frequency of obligate (OBL) plant species
F_{FACW} = frequency of facultative wetland (FACW) plant species
F_{FAC} = frequency of facultative (FAC) plant species
F_{FACU} = frequency of facultative upland (FACU) plant species
F_{UPL} = frequency of upland (UPL) plant species.

Appendix C: Using Non-Vascular Plants to Identify Hydrophytic Vegetation

Sampling of non-vascular plants may be needed when the vascular plant community has been altered or removed by fire or other factors. The use of non-vascular plants in hydrophytic vegetation decisions is discussed in Chapter 5, section on Wetlands that Lack Indicators of Hydrophytic Vegetation. Non-vascular plants, defined here as bryophytes (mosses, liverworts, hornworts), lichens, and fungi, form extensive ground cover in boreal forest, alpine, and polar ecosystems in Alaska (Figures C1 and C2). The non-vascular flora of Alaska is diverse and the identification of species can at times be challenging, even to experts, due to ephemeral or missing fruiting structures and minute differences in morphological characteristics. However, Laursen et al. (2005) and Lichvar et al. (2007) have developed a list of common and relatively easy-to-identify species that are highly associated with wetlands in black spruce communities in the Anchorage and Fairbanks areas of Southcentral and Interior Alaska. The Corps Manual does not specifically include non-vascular plant species in hydrophytic vegetation decisions. However, in this Regional Supplement, the presence and abundance of certain wetland-specialist non-vascular plants are used to help identify hydrophytic vegetation in certain disturbed or problematic wetland situations (see Chapter 5).

Lichvar et al. (2007) identified non-vascular plant species that were strongly associated with wetlands in black spruce communities and, when sufficiently abundant, constitute a nearly “test positive” indicator of hydrophytic vegetation. All of the identified species were bryophytes (Table 7). Wetland-specialist bryophytes were defined as those having 67 percent or higher frequency of occurrence in these wetland types. When one or more of these species comprise more than 50 percent of the total bryophyte cover, the non-vascular plant indicator has a greater than 90 percent probability of association with wetlands. A procedure for identifying hydrophytic vegetation based on the presence and abundance of wetland-specialist bryophytes is described in Chapter 5.

Figure C1. Complex spatial arrangement of non-vascular plant species in the ground layer of a black spruce forest near Anchorage.

Figure C2. Close-up view of non-vascular plant species in the ground layer.

Sampling Wetland-Specialist Bryophytes. To determine whether hydrophytic vegetation is present using the non-vascular plant layer, areal cover estimates are recorded for all bryophytes within a plot. Due to the sorting of different species on the tops of hummocks versus the swales, sampling of bryophytes is restricted to the swales located between and at the base of hummocks using a 10- by 10-in. (25- by 25-cm) quadrat. To ensure that the sampling plots adequately capture species diversity, three quadrats are suggested, placed around the base of the hummocks, if space is available. Data from these three plots can be combined and averaged (see Chapter 5).

Appendix D: Data Form

WETLAND DETERMINATION DATA FORM – Alaska Region

Project/Site: ______________________ Borough/City: ______________ Sampling Date: ________

Applicant/Owner: ______________________________________ Sampling Point: ________

Investigator(s): ______________________ Landform (hillside, terrace, hummocks, etc.): ______________

Local relief (concave, convex, none): ____________ Slope (%): ______

Subregion: ________________ Lat: __________ Long: ____________ Datum: ________

Soil Map Unit Name: ______________________________ NWI classification: ____________

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ______ No ______ (If no, explain in Remarks.)

Are Vegetation ______, Soil ______, or Hydrology ______ significantly disturbed? Are "Normal Circumstances" present? Yes ______ No ______

Are Vegetation ______, Soil ______, or Hydrology ______ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ______	No ______	**Is the Sampled Area within a Wetland?** **Yes** ______ **No** ______
Hydric Soil Present?	Yes ______	No ______	
Wetland Hydrology Present?	Yes ______	No ______	
Remarks:			

VEGETATION – Use scientific names of plants. List all species in the plot.

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
1. ______	______	______	______
2. ______	______	______	______
3. ______	______	______	______
4. ______	______	______	______
Total Cover:	______		
50% of total cover: ______ 20% of total cover: ______			
Sapling/Shrub Stratum			
1. ______	______	______	______
2. ______	______	______	______
3. ______	______	______	______
4. ______	______	______	______
5. ______	______	______	______
6. ______	______	______	______
Total Cover:	______		
50% of total cover: ______ 20% of total cover: ______			
Herb Stratum			
1. ______	______	______	______
2. ______	______	______	______
3. ______	______	______	______
4. ______	______	______	______
5. ______	______	______	______
6. ______	______	______	______
7. ______	______	______	______
8. ______	______	______	______
9. ______	______	______	______
10. ______	______	______	______
Total Cover:	______		
50% of total cover: ______ 20% of total cover: ______			

Plot size (radius, or length x width)______________ % Bare Ground ________

% Cover of Wetland Bryophytes ________ Total Cover of Bryophytes ________
(Where applicable)

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	________	(A)
Total Number of Dominant Species Across All Strata:	________	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	________	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	______	x 1 =	______
FACW species	______	x 2 =	______
FAC species	______	x 3 =	______
FACU species	______	x 4 =	______
UPL species	______	x 5 =	______
Column Totals:	______ (A)		______ (B)

Prevalence Index = B/A = ________

Hydrophytic Vegetation Indicators:

- ___ Dominance Test is >50%
- ___ Prevalence Index is ≤3.0
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ______ **No** ______

Remarks:

SOIL

Sampling Point: ___________

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]One indicator of hydrophytic vegetation, one primary indicator of wetland hydrology, and an appropriate landscape position must be present unless disturbed or problematic.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):

Type: ___________________________________

Depth (inches): ___________________________

Hydric Soil Present? Yes _____ No _____

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Dry-Season Water Table (C2)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ______ No ______ Depth (inches): ____________

Water Table Present? Yes ______ No ______ Depth (inches): ____________

Saturation Present? (includes capillary fringe) Yes ______ No ______ Depth (inches): ____________

Wetland Hydrology Present? Yes _____ No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

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14. ABSTRACT

This document is one of a series of Regional Supplements to the Corps of Engineers Wetland Delineation Manual, which provides technical guidance and procedures for identifying and delineating wetlands that may be subject to regulatory jurisdiction under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act. The development of Regional Supplements is part of a nationwide effort to address regional wetland characteristics and improve the accuracy and efficiency of wetland-delineation procedures. This supplement is applicable to the Alaska Region, which is defined as the entire State of Alaska.

15. SUBJECT TERMS

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